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AN

EXPERIMENTAL AND CRITICAL INQUIRY

INTO THE

NATURE AND TREATMENT

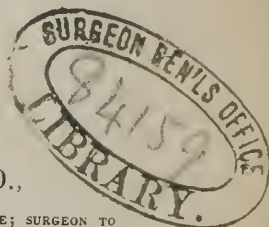
OF

WOUNDS OF THE INTESTINES;

ILLUSTRATED BY ENGRAVINGS.

By SAMUEL D. GROSS, M. D.,

PROFESSOR OF SURGERY IN THE LOUISVILLE MEDICAL INSTITUTE; SURGEON TO
THE LOUISVILLE MARINE HOSPITAL; MEMBER OF THE PATHOLOGICAL
SOCIETY OF PHILADELPHIA; &C. &C.



"The honor of our art, and the moral character of its professors suffer, whenever we pay so blind a deference to any one as prevents us from using our own judgments, and from declaring freely the results of our inquiries or experiments."—*Pou.*

LOUISVILLE:

PRENTICE AND WEISSINGER.

1843.

P R E F A C E .

A monograph on wounds of the intestines has long been an acknowledged desideratum in our surgical literature. The work of Mr. Travers, the only production of the kind in the English language, has been out of print upwards of a quarter of a century, and hence the only information accessible to practitioners, especially to those of the United States, is such as is to be found in the various periodicals of the day, in the transactions of societies, or in our systematic treatises on surgery. The latter, unfortunately, contain little, if anything, that is worthy of reliance; they enter into no details, and some of them do not even allude to the subject; a circumstance so much the more surprising when we reflect upon the importance of these injuries, and the attention which has been bestowed upon them by some of the most respectable members of the profession. In the following pages an attempt has been made to supply this deficiency, by exhibiting a connected view of the subject, embracing an account of the results of my own researches, and of those who have preceded me in the same field of inquiry.

The experiments which form the basis of the present treatise were commenced in the Spring of 1841, and continued, with various intermissions, until a few months ago. The object was, in the first place, to inquire into the process employed by nature in repairing wounds of the intestinal tube; and secondly, and more particularly, to determine, if possible, the value of the more important methods of treatment recommended by surgeons from the time of Ramdohr down to our own. The experiments, amount-

ing altogether to upwards of seventy in number, were performed exclusively upon the dog, as the most eligible animal that could be procured for the purpose. The wound was generally made in the small bowel, not only because it is the more accessible portion of the alimentary tube, but because it is more liable, when thus injured, to become the seat of fæcal effusion, and also, perhaps, of high inflammation. The results are stated, in every instance, with as much brevity as is consistent with a work of this description.

In conducting my experiments, I was kindly assisted by my private pupils, Messrs. Wendell, Comstock, Baker, Shumard, Church, Grant, and Williams. Many of them were also witnessed by Mr., now Dr. Hagan; by Dr. Colescott, one of the Editors of the Western Journal of Medicine and Surgery; by Mr. Mullen, an enterprising and intelligent student; and by Dr. Richard Ferguson, of this city. To the latter gentleman, who has kindly furnished some of the accompanying drawings, together with a number of others that have been unavoidably excluded from the work, I am desirous thus publicly to tender my acknowledgements. The figures illustrative of the methods of Jobert and Reybard have been copied from Bourgery. The wood cuts were executed by Mr. Lovejoy, a young artist of Cincinnati.

It is proper to state that an abstract of this essay was read before the Medical Convention of Ohio, at Cincinnati, in May, 1842. At that time I had not performed any experiments according to Lembert's process, which will account for the remarks which I made respecting it on that occasion, as well as for those which appeared a few months subsequently, in my edition of Mr. Liston's Elements of Surgery.

Louisville Medical Institute, }
July, 1843. *}*

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ERRATA.

Page 6, line 2, for *or* read *and*.

“ 150, line 27, for 1837 read 1827.

INQUIRY

INTO

THE NATURE AND TREATMENT

OF

WOUNDS OF THE INTESTINES.

CHAPTER I.

Of the Nature of Wounds of the Intestines.

The notions of the older writers respecting the nature and treatment of wounds of the intestines were, for the most part, exceedingly crude and erroneous. Neglecting to institute experiments for their successful elucidation, they contented themselves with such facts as they witnessed in the human subject; and as these were not only few, but generally imperfectly noted, the conclusions which they deduced from them were far from throwing any real and substantial light upon this interesting branch of pathology. Indeed, until the publication of the researches of Mr. Travers, of London, early in the present century, the management of wounds and injuries of the alimentary tube was altogether empirical, being regulated rather by accident than sound principles derived from the study of healthy and morbid action. His labors in this department, conducted as they were at an early period of his professional life, evinced no ordinary judgment and talent, and served as a happy presage of the reputation which has

since awaited him. They are comprised in an octavo volume of nearly four hundred pages, including a complete summary of all that was known on the subject at the time at which it appeared in 1812. It is entitled: "*An Inquiry into the Process of Nature in Repairing Injuries of the Intestines; Illustrating the Treatment of Penetrating wounds and Strangulated Hernia;*" and is one of the most able and philosophical productions that have enriched the science of surgery within the last fifty years, so prolific in discovery and improvement.

In the investigations just referred to, Mr. Travers did not, like his predecessors, limit his inquiries to the human subject, but extended them to the inferior animals, upon which, especially the dog, he performed a series of the most interesting experiments, equal in point of beauty and importance to those instituted by his countryman, Dr. Jones, to ascertain the process employed by nature in suppressing hemorrhage from divided arteries. The results of these researches are well-known to the profession, and any further notice of them, excepting in an incidental manner, will therefore be unnecessary in a work of this kind, which is intended more particularly as a record of my own observations and of the facts that have been disclosed within the last quarter of a century. It is but just to say that several years before Mr. Travers issued his work, Dr. Thomas Smith, of the Island of St. Croix, was engaged in making some researches on the same subject, an account of which was published in his Inaugural Dissertation, presented to the Trustees and Faculty of the University of Pennsylvania, in 1805. His object seems to have been rather to inquire into the propriety of using certain kinds of sutures, recommended by Le Dran, Ramdohr, John Bell, and other surgeons, than to ascertain the process employed by nature in effecting reparation. His experiments, twelve in number, were conducted with considerable care, though he has failed, in almost every instance, to notice with proper minuteness the results of his dissections; a circumstance so much the less surprising when

we reflect upon the low state of pathological science at the period at which he wrote. Limited as these researches are, and imperfectly as they have been detailed by their author, they nevertheless tended to establish some important practical precepts, to which allusion will be made in another part of this inquiry.

Before I proceed to detail the results of my own experiments, and the inferences which I have been led to deduce from them, it will not be amiss to make some remarks on the structure of the alimentary tube, the arrangement of the peritoneal cavity, and the phenomena which characterize the presence of wounds in the situation in question.

SECT. I.—*Structure of the Alimentary Canal.*

Into the consideration of the structure of the intestinal canal I do not deem it necessary to enter at any length, as it must be familiar to all who have any pretensions to correct anatomical knowledge. It will be sufficient for the object I have in view to make a few remarks respecting the different tunics, and the manner in which they are united to each other.

The *outer membrane* of the intestinal tube belongs to the class of serous textures, and deserves to be mentioned here chiefly on account of the facility with which it takes on inflammation, and the important part it plays in the reparation of traumatic lesions. It is intimately connected, except along the line of reflection of the mesentery and omentum, to the subjacent muscular tunic, by short, dense cellular substance, and consists every where of a single lamella, the strength of which varies in proportion to the age of the individual. In young animals it is easily lacerated, and incapable of withstanding much traction or pressure. Hence, if, in sewing up a wounded bowel, the ligature be carried merely through the serous investment, it will be almost certain to be torn out in the efforts which are necessary to replace the part within the abdomen. When inflamed, this tunic promptly pours out plastic lymph, which, under favorable circumstan-

ces, becomes readily organized. If the morbid action runs high, the lymph is generally intermixed with serum, and sometimes even with blood. Pus is a more common attendant on the chronic form of the disease; it is, however, occasionally observed in the acute stage, and that, too, within a very short time after the development of the disorder.

The *muscular tunic*, interposed between the preceding and the cellulo-fibrous, to both of which it is intimately connected, is composed of two planes of fibres, a superficial and deep-seated. The first, which is much the more delicate of the two, is made up of thin, pale fibres, which are arranged longitudinally, and which exhibit certain, but as far as the present inquiry is concerned, unimportant peculiarities in different parts of the tube. The second layer consists of circular fibres, much more distinctly marked than the preceding, which extend in parallel lines round the entire circumference of the bowel, their extremities being inserted as it were into each other.

Lying beneath this muscular plane is the celebrated *nervous tunic*, as it was called by the ancient writers. Alternately admitted by some and rejected by others, this layer has been recently described by Mons. Cruveilhier,* under the name of the *fibrous lamella*, in consideration of its structure, which closely assimilates itself to that class of tissues. It is intimately connected, on the one hand, with the mucous membrane, and, on the other, with the muscular tunic, into the latter of which it sends a large number of processes, of a dense, firm character, which thus tend to strengthen the union between them. In its thickness and consistence it varies in different portions of the canal, being at its minimum in the ileum and colon, and at its maximum in the remainder of the small and large bowels. Strong and resisting, it is semi-transparent, devoid of elasticity, and composed of condensed cellular tissue, in which it is impossible to distinguish any of that linear disposition so conspicuous in the fibrous membranes.

*Anatomie Descriptive, T. ii, p. 470.

properly so called. The filaments of which it consists interlace with each other in every conceivable manner, forming thus a very close net-work, which it is difficult to unravel by insufflation and other artificial processes. In great obesity small particles of fat are occasionally to be seen in its meshes, which always disappear in emaciation, however induced. In chronic affections, especially in such as are of a malignant nature, this tunic is often remarkably altered in its structure, being rendered much thicker than in the normal state, at the same time that it assumes a dense and almost gristly hardness. It readily re-unites when divided, as I have witnessed in numerous experiments, and deserves to be attentively studied, as it is the membrane through which the surgeon should always carry his needle in sewing up wounds of the intestines.

This tunic—for so indeed it should be considered—is much more distinct in carnivorous animals than in herbivorous, or than in the human subject. In the small bowel of the African lion it is an exceedingly firm, dense, and elastic texture, of a white opaque aspect, capable of great resistance, and nearly half a line in thickness. In the bear its characters are nearly similar. In the dog it is less strong, and also less distinctly fibrous, yet more so, considerably, than in the human subject. In the horse it forms a thick inelastic layer, of a dull greyish color, which frequently contains a good deal of adeps. In the ox its properties are very much of the same nature.

The *internal membrane*, of a mucous character, varies in thickness and consistence, as well as in the mode of its arrangement, in different parts of the tube, and does not require any particular notice in relation to the subject under consideration. It is sufficient to observe that it is highly vascular and sensitive; that it re-unites with great difficulty, comparatively speaking, when divided; and that, although extremely prone to inflammation, it rarely, when thus affected, deposits plastic lymph, the constant and invariable product of peritonitis.

SECT. II.—*Nature and Extent of the Peritoneal Cavity.*

Is there any cavity, properly so called, in the peritoneal sac, and, if so, what are its nature or capacity? Concerning this question various views have been expressed by anatomists and surgeons, and it is important, therefore, that it should be carefully examined before we pass an opinion on it, either affirmatively or negatively, as our decision, whatever it may be, must be calculated to exert no inconsiderable influence upon the treatment of traumatic lesions of the alimentary canal. Mr. John Bell, in his *Principles of Surgery*,* affirms that, "there is not, truly, any cavity in the human body, but that all the hollow bowels are filled with their contents—all the cavities with their hollow bowels—and that the whole are equally and fairly pressed." That this is really so every one will admit; but when he declares, as he does almost in the same sentence, that all the viscera of the abdomen may be deeply wounded, and yet no blood or fæces can escape, he makes an assertion which is unsustained by facts, and which daily observations on the human subject, as well as experiments upon the inferior animals, wholly disprove. Examples of fæcal effusion, either alone or in combination with blood, are mentioned by a great number of pathologists, by Hoyerus, Ravaton, and Morgagni, of the last century; by Cooper, Travers, and others, of the present. Indeed, there is literally no end to cases of this description—a volume would scarcely suffice to record them all; for there is hardly a physician, at all extensively engaged in practice, who has not met with them. A few years ago I assisted my colleague, Professor Cobb, in examining the body of a stout, athletic man, who had been stabbed in the abdomen, apparently with a dirk, which had entered near the umbilicus, and perforated the jejunum, laying open that tube in an oblique direction to the extent of nearly half an inch. Through this

*Vol. i, p. 487. London, 1827.

aperture a small quantity of stercoraceous matter had made its way into the peritoneal sac, where it induced violent inflammation, of which the patient died in less than two days.

Moreover, certain pathological facts clearly show the fallacy of the above opinion. In ulceration of the bowels the morbid action occasionally extends to the serous investment, which it at length perforates, leading thus to a discharge of fæcal matter. Of this not less than five or six well-marked cases have fallen under my own observation, and numerous others of a similar kind are narrated by authors. This occurrence must, in fact, inevitably happen whenever nature fails to effect adhesion in the surrounding parts, however slight the opening. In several of my cases the aperture did not exceed two lines, or the sixth of an inch in diameter, and in some of those that have come under the notice of other observers, it was still smaller, scarcely equalling the size of a crow-quill. Additional facts have been furnished by Smith and Travers, in their experiments on dogs. My own researches have afforded the following results.

Having opened the cavity of the abdomen of a small slut, a transverse wound, half an inch long, was made into the jejunum, and the part returned without suture. The animal became sick soon after the operation, and evinced a disinclination to move about. In thirty-two hours she died. The aperture in the bowel was perfectly patulous, with the mucous coat everted, of an oval form, and without the slightest attempt at reparation or adhesion to the circumjacent structures. About six ounces of a dirty yellowish looking fluid, evidently of a fæculent nature, were contained in the peritoneal sac; and there was extensive inflammation of the omentum, together with the serous coat of the bowels, several coils of which adhered with tolerable firmness to each other.

In another experiment, the subject of which was a small dog, and in which the incision was of the same extent and direction, the results were of a similar character. The animal became sick shortly after the operation, and continued

in that condition for thirty-six hours, when he died. On dissection, the edges of the wound were found to be in a gaping state, without any apparent effort at restoration; some hardened and fluid fæces had escaped into the abdominal cavity; the bowel was red and contracted for several inches above and below the affected part; and the neighboring knuckles of intestine were agglutinated by plastic lymph.

In a third experiment, in which the wound was only four lines, or the third of an inch in length, and in which the bowel was replaced without suture, recovery occurred without any untoward symptoms, and without any apparent inconvenience to the animal.

Oblique wounds, six lines long, and treated without suture, were followed by the same result as transverse wounds of the same extent. Only two experiments were performed to elucidate this point. The particulars it is unnecessary to detail. It will suffice to say that, in one of the dogs, death took place in thirty-six, in the other, in forty-seven hours, from peritoneal inflammation, occasioned by the effusion of fæculent matter. The wounds in both were in a gaping, patulous state, without any evidence whatever of reparation by the adhesive process.

To ascertain whether a longitudinal wound, six lines long, would be attended with the same degree of danger, was the object of the next experiment. For this purpose a healthy, full grown dog, of moderate size, was selected. Soon after the operation he vomited, and appeared to be in great agony; in thirty-six hours he died. On opening the belly, a considerable quantity of gas, of a highly offensive odor, escaped with a loud noise. Both hardened and fluid fæces were contained in the peritoneal sac, the enteric portion of which, especially in the immediate vicinity of the wound, exhibited marks of violent inflammation. The edges of the wound were separated to the extent of at least two lines, and through the opening thus formed the mucous membrane projected beyond the level of the serous covering. No attempt had been made to re-es-

tablish the continuity of the tube by adhesions of the gut to the surrounding parts.

In a second experiment, in which the wound was only four lines long, speedy recovery followed. The dog was a good deal indisposed for the first forty-eight hours, after which he became well and lively, and continued thus until he was killed on the fifteenth day after the operation. A process of omentum occupied the outer wound, which was nearly healed, the small bowels were extensively matted together, and the reparation of the enteric breach had evidently been effected by the adhesion of its edges to the two neighboring coils of intestine. The bottom of the wound was nearly two lines in width at its middle, and imperfectly filled with lymph.

A large dog, killed nine days after having been stabbed with the sword of a cane, two lines in diameter, presented the following appearances: two punctures, distant about five inches from each other, were found in the small bowel; the edges of each were in close contact, and their outer surface was completely covered with plastic lymph, which was quite firm, slightly ecchymosed, and vascular. The animal retained his original embonpoint, and did not appear to have suffered materially from the injury which had been inflicted upon him.

From the foregoing observations and experiments, the following conclusions may be established:

First—that, although there is not, in the true sense of the term, any peritoneal cavity, yet the arrangement existing between it and the enclosed viscera is of such a nature as to admit, and that very frequently, too, with great readiness, the effusion of stercoraceous matter in wounds and ulcerative perforation of the bowels.

Secondly—that wounds of the bowels to the extent of six lines, whether transverse, oblique, or longitudinal, are almost always, if not invariably, followed by the escape of fæcal matter, and the consequent development of fatal peritonitis.

Thirdly—that wounds not exceeding four lines in length, no matter what may be their direction, are not near so apt. if

left to themselves, to be succeeded by the extravasation of the contents of the intestinal tube; and that, in the majority of cases, nature, properly aided by art, is fully competent to effect reparation.

These deductions derive additional support from the following experiments, instituted with a view to ascertain the effects of wounds and punctures of different forms and dimensions: 1. A longitudinal incision, two lines and a half in length, immediately contracted to one line and three-quarters, with a sufficient amount of eversion of the mucous lining to close the resultant orifice. 2. A similar wound, four lines long, diminished in a few seconds to three lines, by one line and a half in width; it assumed an oval shape, and the internal membrane protruded on a level with the peritoneal covering, leaving no perceptible aperture. 3. An oblique cut, seven lines in length, contracted to five, by two and a half in width, with marked eversion of the mucous lining. 4. A transverse wound, two lines and a half long, was reduced almost instantaneously to two lines in diameter: it was of a rounded form, and the two outer tunics of the gut retracted so as to expose the mucous membrane. 5. In another experiment, in which the incision, likewise transverse, was half an inch in extent, the orifice assumed a rounded, oval shape, and was reduced to four lines, by two and a half in width, the internal coat exhibiting, as in the other cases, a pouting, or everted arrangement.

These observations are interesting chiefly as showing the efforts which nature institutes to close a breach of this kind, the very moment almost it is inflicted. It is doubtless by a process of this description that the effusion of stercoraceous matter into the peritoneal sac is so generally prevented in those cases in which the solution of continuity is of small extent, not exceeding, for example, a few lines in diameter, and where, consequently, it amounts rather to a puncture than a wound. The eversion of the lining membrane forms a striking and constant feature in injuries of this character,

and may be compared, in its effects, to the contraction and retraction observed in the extremities of a divided artery.

It is a circumstance in the highest degree interesting, and worthy of notice, that the eversion of the lining membrane, which is so conspicuous in traumatic lesions of the alimentary tube, is never witnessed in the openings which result from ulcerative action. In the latter, the perforation proceeds in a slow and gradual manner, at the expense mainly of the mucous and fibrous lamellæ, which are always destroyed to a much larger extent than either the muscular or peritoneal. Hence, by the time the ulcer reaches the surface, it is impossible for the lining membrane to protrude across it, as it does when the bowel is wounded by a sharp instrument, a blow, or a kick. Another circumstance which no doubt contributes to produce this result, is the indurated condition of the serous and muscular layers immediately around the perforation, caused by the deposition of lymph during the progress of the ulcerative action.

There is thus a striking difference, as respects their immediate effects, between an opening of the bowel from ulceration and one produced by an incised or lacerated wound. In the former, although it may not be two lines in diameter, extravasation would be almost certain; in the latter, it might be nearly double that size, and yet, for the reason just mentioned, that event, so much to be dreaded, would be little likely to occur.

It is much to be regretted that Mr. Travers, in the experiments which he instituted to illustrate this branch of the subject, as well as in the cases which he has adduced from his own and the practice of others, has not specified the size of the lesion; a matter of such paramount importance that it is only surprising how it could have been overlooked. His chief object, however, appears to have been, not so much to deduce from them any practical precept in reference to the management of such accidents, as to show that the apprehension of intestinal effusion in penetrating wounds of the abdomen, is,

in the majority of cases, without foundation. How far he has succeeded in accomplishing this end, I leave it to others to determine.

SECT. III.—*Symptoms, Diagnosis, and Prognosis.*

The next topic into which I proposed to inquire is the consideration of the symptoms of wounds of the intestines. A few remarks under this head will be sufficient for the object in view.

The symptoms of a wounded bowel necessarily divide themselves into two classes, into those, namely, which are furnished by the system at large, and those which are peculiar to the part more directly and immediately implicated. In regard to the first, they are such, generally, as denote a severe shock of the nervous system, but as they are common to this and other injuries, they are of little consequence in enabling us to make out the diagnosis. In almost all instances there is nausea, either alone, or accompanied with vomiting; these symptoms often make their appearance within a few minutes after the infliction of the wound, and continue with great obstinacy for several successive days, or, in fatal cases, until death relieves the patient of his suffering. They are commonly more violent and distressing in lesions of the small than of the large bowel, owing to the more delicate organization of the former than of the latter, and to its more intimate connexion with the stomach and the sympathetic nerves. The prostration of the vital powers is not always in proportion to the extent of the wound, or the danger of the case. Some persons, it is well-known, suffer much more severely from a slight than others do from a violent injury, for reasons which cannot always be explained, but which may be supposed, generally, to be dependent upon some constitutional peculiarity. Reaction is often postponed for ten or fifteen hours after the occurrence of the accident, and until it is fairly established there is sometimes a constant tendency to syncope, with an alarmed and agitated state of the mind,

which it is almost impossible to calm or subdue. The countenance under such circumstances has a pale, anxious, and haggard expression; the pulse is small, frequent, and tremulous; the skin is bathed with clammy perspiration; the extremities are cold; the patient tosses about in his bed; the thirst is urgent, as is also the desire for cool air; there are griping pains in the abdomen; and occasionally the discharges from the bowels are involuntary. Conjoined with these symptoms there is sometimes slight delirium with partial blindness or indistinctness of vision.

The *local symptoms* of a wounded intestine are often as equivocal as those which are furnished by the constitution. This must, indeed, always be the case when there is no protrusion of the tube, or when the external opening is so small, or its direction and situation are such, as to prevent effectually the escape of fæces or other matters. It not unfrequently happens that an instrument enters the abdomen, and passes out at the opposite side, directly in the course of the bowels, without in any wise interfering with them. Many interesting and instructive cases of this kind are recorded by writers on military surgery, as well as by civil practitioners, and several will be quoted hereafter in illustration of this part of the subject. The most characteristic signs of this lesion are, unquestionably, the escape of fæces, bile, food or fœtid air from the external wound, and the sudden development of tympanites. The latter symptom, which does not appear to have been sufficiently insisted upon by systematic writers, as very few, if any, mention it, is often present when the others are absent, and may therefore be regarded as in some degree pathognomonic. Jobert thinks it is the most valuable and positive sign of a wound of the intestine that we can have when there is no external opening, or only so small a one as not to permit the egress of stercoraceous or other substances. He relates several instances from his own practice and that of others, in which, by this phenomenon alone, the diagnosis was clearly established. The tympanites supervenes at various periods, from a few minutes to several hours, after the

occurrence of the accident, and is always attended with a hollow, drumlike sound on percussion, with tenderness on pressure, and difficulty of respiration. The following cases will more fully explain the nature and importance of this symptom.

A young man, eighteen years of age, of an excellent constitution, an apprentice in a drug-store, in a rencounter with a robber, in May, 1842, was stabbed with a knife in the right side of the abdomen, the instrument entering the anterior wall of the ascending portion of the colon in a transverse direction, and about two inches above the ileo-cæcal valve. The outer wound was fifteen lines in length, and the inner was sufficiently large to allow the escape of a considerable quantity of fæcal matter. A short time after the occurrence of the accident there was diffuse pain of the abdomen, with a discharge of blood from the anus, and at the end of twenty-four hours decided tympanites. The distention progressively augmented for four days, when it had attained an enormous height. From this period it slowly subsided, but did not entirely disappear under a month. Pressure on the abdomen during the first week occasioned the most exquisite pain. The patient finally recovered under the judicious management of Dr. E. S. Williams and Professor Mussey, of Cincinnati, where the case occurred, and where, through the politeness of those gentlemen, an opportunity was afforded me of seeing it, during a visit which I made to that city last summer.

A carriage-driver, sixty years of age, was kicked by a horse upon an old rupture in the left groin, for which he was carried to the St. Louis hospital of Paris. The following morning he had great pain in the belly, especially on pressure, and the swelling, which was very large and emitted a peculiar gurgling noise, was tympanitic. He died the next day under all the symptoms of gangrene or rupture of the intestine. The scrotum, hernia, and belly, were all distended with gas, which could be readily forced from one to the other; the intestinal folds were agglutinated by plastic lymph; black matter was

effused into the pelvic and abdominal cavities; and the small bowel was entirely torn across.*

A young man, twenty-one years of age, was thrown from his carriage, the wheel of which passed over his belly. When brought to the St. Louis hospital, immediately after the accident, the skin of the abdomen was found to be perfectly natural, but he complained of great pain, and there was enormous tympanites, the parts on percussion sounding like a drum. His sufferings for eight days were very violent, after which they gradually subsided, and he was rapidly convalescing from his injury, when, at the end of a month, an unexpected attack of pleuro-pneumonitis occurred, which quickly destroyed him. The jejunum adhered to the last false rib, and presented the remains of an opening, which had been completely closed by a sort of plug of the omentum.†

A man affected with cancer of the rectum was admitted into the surgical ward of the St. Louis Hospital under the care of Mons. Richerand. The abdomen became suddenly tympanitic, and this distinguished surgeon at once pronounced the case to be one of intestinal perforation. The autopsy justified the diagnosis. The bowel was found to have given way above the seat of the disease, and thus permitted the escape of the gas upon which the distention depended.‡ Examples of a similar character are recorded by Scarpa, Sévestre, Kapeler, Marjolin, and other writers.

Tympanites, however, does not attend all traumatic injuries of the intestinal canal. When the opening is very small, amounting rather to a puncture than a wound, the escape of gas will either be entirely prevented, or occur only in a small degree, owing to the protrusion of the mucous membrane, which, as was seen in a previous part of this essay, is a constant phenomenon in lesions of this description. A sort of valve

*Jobert, *Maladies du Canal Intestinal*, T. i, p. 61.

†Ibid. T. i, p. 62.

‡Ibid. T. i, p. 63.

is thus formed, which opposes an effectual barrier to the egress of fæcal matter, intestinal secretions, and even air.

A discharge of blood from the anus is another symptom which, in connexion with some of those already pointed out, is of considerable importance in the discrimination of the lesion before us. Still, as it may, and often does attend other injuries, it cannot be regarded as at all characteristic. The quantity of blood evacuated occasionally amounts to many ounces. In the case previously adverted to, which I saw along with Professor Mussey and Dr. Williams, at least two pints of fluid and grumous blood were discharged during the first three days. It began to pass off seven hours after the occurrence of the injury, nearly unmixed with fæces, and comparatively fresh in its appearance. What was subsequently evacuated was of a darker color, and more firmly coagulated, as if it had been retained for sometime in the bowel.

Equally equivocal is hematemesis, or vomiting of blood which may be enumerated as another, though by no means constant symptom of traumatic lesion of the alimentary tube.

The degree of pain accompanying wounds of the intestines varies remarkably in different individuals, being very slight in some, and exceedingly severe in others. In most instances it is of a colicky character, though occasionally it is dull and aching, and it is almost constantly increased by pressure, by coughing, and by a full inspiration, especially if some hours have elapsed since the infliction of the injury.

The wound is occasionally complicated with hemorrhage into the peritoneal sac, caused by lesion of the epigastric or internal mammary artery, of some of the branches of the mesentery or omentum, of the aorta or vena cava or of some of their immediate offsets. Unless the abdominal wound be large, very little blood, if any, will appear externally, but it will flow into the serous cavity, where it will occupy the intervals between the intestinal convolutions, descend into the pelvis, or be extensively diffused among the viscera. The amount and rapidity of the effusion will vary in proportion to the size of the wound and the volume of the vessel con-

cerned. When the vessel is very large and the opening considerable, the hemorrhage may be instantly fatal, or death may ensue in a few hours. In cases of an opposite character the symptoms will be less urgent, and the patient probably suffer no inconvenience, save what results from the temporary debility and faintness. The blood will soon coagulate, and by the pressure which it exerts upon the orifice of the bleeding vessel, a mechanical obstacle will be opposed to its further effusion.

When the quantity of fluid poured out is considerable a tumor is sometimes formed, which may be easily detected by its prominence and hard feel. If the patient survive the immediate shock of the accident, he may die from inflammation, caused by the clotted blood acting as an extraneous substance. At other times the coagula are absorbed, or they become encysted by an exudation of plastic lymph.

In the *diagnosis* of a wounded bowel important information may frequently be obtained, in regard to the direction, extent, and depth of the lesion, by a careful consideration of the shape and size of the vulnerating body. When the outer opening is so large as to admit the finger, it will generally be easy to determine whether the injury reaches the cavity of the abdomen: probing with instruments is quite inadmissible; it can do no good, and may occasion much harm. It need hardly be observed that it is highly proper, in every inquiry of this kind, to place the patient as nearly as possible into the posture in which he was at the moment of the accident. When the wounded bowel protrudes at the external opening, the diagnosis is at once obvious, as the nature and extent of the injury may be determined by simple inspection. The lesion, in the absence of pathognomonic symptoms, ought to be suspected when nausea and vomiting occur after penetrating wounds of the abdomen, accompanied with griping pains, great debility and faintness, jactitation, extreme anxiety, and cold sweats. The case is plain enough when there is a discharge of the contents of the alimentary tube, or a sudden development of tympanites.

It not unfrequently happens that an instrument enters the abdomen, and passes out at the opposite side, without, in the slightest degree, interfering with the bowels or other viscera. Many interesting cases of the kind are related by writers. I select the following in illustration of the subject.

A young soldier received, in a duel, a thrust from a sabre on the anterior part of the abdomen, a little above and to the right of the umbilicus. The walls of the belly were divided, and a considerable mass of omentum protruded through the opening. The patient was removed to the hospital, where every attempt was made to reduce the prolapsed parts, but without success. Blood was freely abstracted from the arm, leeches, cups, and fomentations were applied to the abdomen, and perfect quietude was enjoined; in short, every thing was done to prevent peritoneal inflammation. Eight days after the reception of the injury the extruded omentum was cut off, after which the wound became covered with healthy granulations, and at the end of five weeks the man was nearly well.*

The following case, mentioned by Sir Astley Cooper,† is strikingly illustrative of the manner in which the intestines glide away from the edge of the instrument. He was called to a female whom he found lying on the floor, weltering in her blood, from the infliction of four wounds upon her throat, in an attempt to commit suicide. Having closed these with sutures, his attention was directed, by some incoherent remark which she made, to her abdomen, where he found the bowels exposed by a wound reaching nearly from the pubes to the ensiform cartilage of the sternum. After cutting her throat with a razor, she had ripped up her belly with it, and let out her bowels, which were still distended with air, and had not sustained the slightest injury.

Dr. Hennen states‡ that he was witness to the recovery of

*Medico-Chir. Review, vol. ix, p. 527.

†Ibid., vol. ix, p. 528.

‡Principles of Military Surgery, p. 319. Phila., 1830.

a soldier who was shot through the body with a ram-rod at the siege of Badajos, in 1812. The instrument entered the front of the abdomen, and actually stuck in one of the transverse processes of the vertebræ, from which it could not be disengaged without force. An analogous case is related by Dupuytren.*

A man in a fit of severe grief resolved to put an end to his existence, and for this purpose rushed with all his force against the point of a sword, which he had previously fastened in the wall of his apartment. So completely was the abdomen transfixed that the point of the weapon stuck out for eight or ten inches on the right side of the spine. When Dupuytren saw him, he seemed to suffer but little pain, and there was no symptom of any extravasation, or, indeed, of a wound of any of the abdominal viscera. It required considerable force to withdraw the sword. By repeated bleedings and the employment of a very rigid antiphlogistic regimen, the patient speedily recovered.

Richard Wiseman mentions the case of a young man who was run through with a rapier, which entered at the right hypochondriac region, and passed out at the back. On the following day his skin was hot, and the pulse somewhat accelerated, but there was no tension of the abdomen, colic, vomiting, or any thing denoting injury of the intestine, or any other viscus, and he recovered in a very short time. "Thus," says Wiseman, "it frequently happeneth that a sword passeth through the body without wounding any considerable part.†" Two similar cases are recorded, one by Lamotte,‡ and the other by Garangeot, in each of which a sword passed directly across the cavity of the abdomen, without injuring a single fold of the intestinal tube.

Numerous instances of penetrating gunshot wounds of the

*Medico-Chir. Review, vol. xxi, p. 301.

†Chirurgical Treatises, p. 373., 4to. London, 1676:

‡Traite Complet de Chirurgie, T. ii.

abdomen are recorded, in which the bowels appear to have completely escaped injury. A case, which was evidently of this nature, is mentioned by Dr. John W. Richardson, of Tennessee, in the fourth volume of the *Western Journal of Medicine and Surgery*.* The ball, which weighed two drachms and a half, entered the abdomen on the right of the median line, and issued midway between the last rib and the sacro-iliac symphysis, immediately on the right side of the spine. There was no escape of gas or fæculent matter from the wound; some bloody urine was discharged soon after the infliction of the injury, and for the first eight or ten days there was considerable tension with soreness and swelling of the abdomen. The whole treatment was very simple, and the patient recovered in less than a month.

When the ball does not pass entirely through the body, it may be retained in the peritoneal cavity, or, if it wound the bowel, it may at once fall into the latter, and be discharged by stool. In the former case the foreign body excites adhesive inflammation, by which it becomes encysted; after it has remained in this condition, however, for a while it usually induces suppurative action, which gradually extends to the coats of the intestine, and finally produces perforation, whereby an outlet is established for its evacuation. When the extraneous substance is very small, as, for example, a shot, or even a small bullet, it occasionally continues encysted for many years, or even during the remainder of life, without occasioning any ill effects. An instance in which a number of encysted shot were found in the peritoneum recently occurred in the Louisville Marine Hospital, in an old man who had been wounded by a musket ten or twelve years previously. He soon recovered from the injury, to which he never referred any of his subsequent ailments.

I shall conclude this citation of authorities with the following extraordinary case recorded by Dr. Hennen, in his work

* This case is reported as having involved the colon and small intestines, without any evidence whatever that this was the fact.

on Military Surgery. A soldier of the Brunswick corps was wounded on the 16th of June, 1815, by a grape shot, which struck the right arm near the elbow, the articulation of which was destroyed. An English surgeon amputated the limb some hours after. The patient remained that night at Genappes. Next morning he observed blood flowing through the bandages, and requested Dr. Spangenberg, physician-in-chief to the Hanoverian army, to examine the arm. He found the humerus split as far as the joint, and with the consent of the patient immediately extracted it. After having dressed the parts, the man complained of pain in the abdomen, which was ascertained to proceed from a wound caused by a grape shot, which had passed through the exterior part of the belly, leaving two openings, one in front and the other behind, through each of which a portion of intestine protruded, not injured or inflamed, but in the natural state. The bowel, smeared with oil, was carefully reduced, and the two apertures were covered with adhesive plaster. The patient was brought to the hospital at Laecken, on the 19th of June, with moderate fever, and very little pain in the abdomen, or in the wound of the arm. The functions of the intestinal tube were not disturbed. He took little or no medicine; in four weeks the sores in the arm were cicatrized, and those of the abdomen, which were slightly affected with gangrene, in about three months.

The *prognosis* of wounds of the intestines must necessarily be influenced by a great variety of circumstances, such, particularly, as the extent of the mischief, the nature of the vulnerating body, and the state of the patient's health at the time of the accident. A small and simple lesion will be much more likely to turn out favorably than one involving a large surface, or one complicated with injury of some other organ, or the perforation of a large vessel. It is also less serious in an incised than in a contused or lacerated wound, and in a superficial than a deep one. Persons occasionally perish from the most trivial accidents of this kind, from the mere shock probably of the nervous system; they lie in a pale and ex-

hausted condition, and death takes place unpreceded by reaction. On the other hand, recovery sometimes occurs under circumstances apparently the most desperate and unpromising. No certain rule can, therefore, be laid down in respect to the prognosis of wounds of this description; which, however, must always be considered as severe accidents, likely to be followed by the worst consequences. Wounds of the large bowel were regarded by the ancient surgeons as less serious than those of the small; a view in which most modern authors seem to concur. The reason of this difference is, first, the more fixed condition of the lower portion of the tube; secondly, its more capacious calibre; and thirdly, the more solid nature of its contents. These circumstances may all be supposed to be favorable to the prevention of the effusion of fæcal matter. Extravasation will also be less apt to occur when the bowel is empty than when distended.

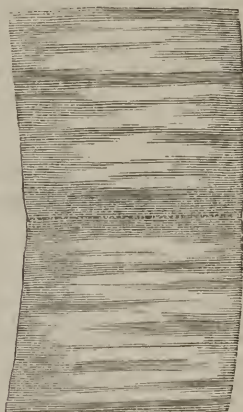
When the contents of the bowel are effused over the peritoneum, death is sure to take place from the effects of inflammation. Occasionally, as was before intimated, life seems to be destroyed by the shock sustained by the nervous system within a few hours after the accident, and before the constitution has had time to rally. The fæcal extravasation, when slight, is sometimes limited by the deposition of plastic lymph, and the discharge of it is ultimately promoted by the formation of an abscess; or chronic action is established in the serous membrane, and the patient, after weeks or months of suffering, sinks under the exhausting influence of the malady. In the great majority of instances, however, death is induced by acute peritoneal inflammation. The symptoms presented are violent burning pain of the abdomen with great tenderness on pressure; intense thirst; a sharp, frequent, and contracted state of the pulse; constipation of the bowels; coldness of the extremities; constant wakefulness; great anxiety and restlessness. In the latter stages there is generally some degree of nausea with occasional vomiting; the pulse is weak and fluttering; the surface is bathed with a cold clammy sweat; the features are collapsed; the breathing is oppressed and labori-

ous; the belly extremely tense and tumid; the patient is harassed with cough, his strength rapidly forsakes him, and he dies under all the symptoms of one sinking from the effects of mortification. The attack rarely continues beyond forty-eight hours, and often terminates fatally in a much shorter period. The appearances after death are always well-marked when the disease has been protracted. The peritoneal surface is highly inflamed, the bowels are covered with lymph, and the abdominal cavity usually contains a small quantity of turbid serum. The intestinal coils are frequently united to each other and to the neighboring parts, and on penetrating the belly there is almost always an escape of fœtid gas.

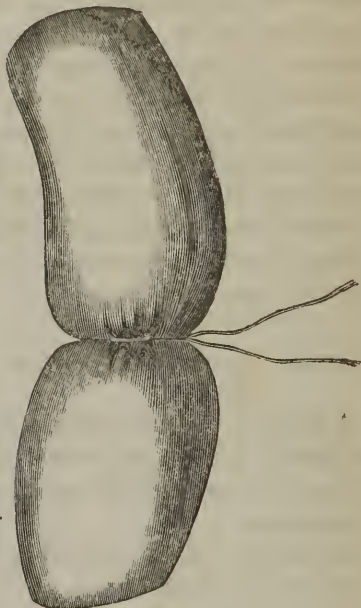
SECT. IV.—*Mode of Reparation.*

I come, in the next place, to consider the process employed by nature in repairing wounds of the intestinal tube, and the mode in which she disposes of the ligature used in securing their edges.

If a small circular ligature be drawn firmly round the bowel of a dog, or other animal, the resulting effects will be very similar to those which attend the ligation of an artery. The opposite surfaces will not only be forced into close contact with each other, but it will produce at the same time a complete division of the mucous coat. If the cord be pulled very tightly, there will be in addition, especially in young subjects, a partial separation of the cellulo-fibrous lamella and of the muscular fibres. These effects I have repeatedly witnessed in my experiments on dogs, and they may be readily produced in the human body after death. If a flat ligature be used, even when



it is drawn with considerable firmness, the opposite surfaces of the tube are merely brought into contact, without any rupture of the substance of any of the tunics. The only exception to this is where the animal is very young and the parietes of the bowel are unusually tender; in which case there will be occasionally a slight division of the lining membrane, but not of the muscular fibres. When a narrow ligature is used, the parts above and below it are so closely approximated that they touch in the greater portion of their circumference; a circumstance which must necessarily exert a most favorable influence over the reparative process and the re-establishment of the continuity of the canal.



Soon after an operation of this kind, in which a narrow circular ligature is used, inflammation is set up, plastic lymph is deposited upon and around the constricted parts, ulcerative absorption is established, and the cord at length works its way into the intestinal tube, where it is discharged along with the fæces. The period required for the detachment of the ligature may be supposed to be influenced by various circumstances, the principal of which are referable to the form and size of the foreign substance, together with the force with which it is applied, the thickness of the different tunics of the bowel, the age of the subject, and the state of the general health at the time of the operation, as well as immediately after it. In a small but full grown dog, killed at the end of the third day after the experiment, the ligature, which was round and narrow, had found its way through more than one-

half of the circumference of the tube, and in another animal of the same kind, which died from the effects of the operation thirteen hours later, the progress of the foreign body was still greater. In the latter, indeed, the cord had entirely disappeared, having lost its hold, and escaped into the bowel, in which, after a minute examination, it was discovered at the distance of several feet from the seat of the injury, surrounded by fæcal matter. In both cases the continuity of the parts was thoroughly re-established by an abundant deposition of lymph, which, notwithstanding the brief period that had elapsed, exhibited already well-marked traces of organization. The bowel, however, presented in each instance a constricted appearance; and in one of the animals, that, namely, which was killed at the end of the third day, the opposed mucous surfaces were still in close contact, no attempt having apparently been made to restore that portion of the tube. In the other the parts were not only perfectly continuous with each other, as has just been intimated, but the cavity was partially re-established. In a third experiment, performed on a middle-sized dog, not more than eighteen months old, the ligature was found lying at the seat of the constriction, where it was retained by a layer of plastic lymph, which had sealed up, as it were, the surface of the fissure in the mucous tunic. The canal of the bowel was completely restored, and the bond of connexion between the divided parts firm and organized. The animal was killed on the eleventh day. (Pl. fig. 1, 2.)

The following experiment was performed by Mr. Travers, and is recorded in his work on wounds of the intestines. A ligature of thin pack thread was firmly tied around the duodenum of a dog, so as completely to obstruct it. The ends of the string were cut off, and the part returned. On the fifteenth day, his cure being established, he was killed. A portion of omentum connected to the duodenum was lying within the wound, and the folds contiguous to the strictured intestine adhered to it at several points. A slight circumferential depression was observed in the duodenum, and the mucous surface was more vascular, as well as of a deeper color, than

usual. A transverse fissure marked the seat of the ligature. The edges of the sections were distinctly everted, and the appearance corresponded with that of the union by suture.

The lymph which is effused upon the external surface of the bowel, consequent upon the operation, gives the part at first a rough uneven appearance; but after a few weeks, sooner or later, according to circumstances, it undergoes a sort of modelling process, and hence, if the animal survive several months, it is generally no easy matter to determine the seat of the injury. In a dog which was killed four months after the experiment was performed, the reparation was so perfect that, had it not been for the attachment of a small process of omentum, it would have been impossible, by mere external inspection, to discover the place where the cord was originally applied, such were its smoothness and polish. Nor was this confined solely to the outer surface of the tube. Internally the cicatrization was almost as complete, the continuity of the mucous membrane having been every where re-established. There was scarcely even a seam at the original seat of the constriction. (Pl. fig. 3, 4.)

It will thus be perceived that, from the rapid manner in which the ligature is detached, there is no danger that the animal will suffer much inconvenience from the want of a passage. Indeed, when the ligation is made in the small bowel, or high up in the large, the alvine discharge may go on with the same facility as before, making allowance of course for the pain which must necessarily attend an operation of such severity.

Effects similar to the above are produced when a ligature is applied round the edges of a small wound, that is to say, from two to three lines in diameter, provided it be drawn with sufficient firmness not to slip off. The cord gradually cuts through the different coats of the bowel, and the continuity of the canal is re-established by the effusion of plastic lymph upon the constricted part. The process of reparation, however, is not so speedily completed, owing to the breach being much wider than when a ligature is simply cast round the

tube. In this case the mucous membrane is reproduced only after a long time, and the amount of lymph required is proportionally much greater. The ligature is detached at a period varying from five to ten days.

Wounds and punctures of the bowel, unaccompanied by the effusion of fæcal matter, heal, when left to themselves, either by the adhesion of their edges to the surrounding parts, or by the deposition of lymph upon their surface and the gradual approximation of their lips. In the majority of cases the reparation is probably effected by the former method; since there is always a great tendency in the wounded structures to attach themselves to those in their immediate vicinity. Even wounds of large size are occasionally repaired in this manner. In some instances, again, the breach is closed by a piece of omentum, which projects into it, and fills it up like a tampon. When this happens the serous membrane is firmly fixed to the edges of the opening, and the part which corresponds with the interior of the canal and assists in maintaining its continuity, is eventually absorbed; an occurrence which leads to the gradual approximation of the lips of the wound and their ultimate re-union. Jobert thinks that this mode of reparation is not uncommon, an opinion in which my observations do not induce me to concur. That it takes place occasionally is certain, for I have several times witnessed it in my experiments. He refers to a case, reported by Dr. Quercial of Toulouse, of perforation of the jejunum, in which the epiploon projected into the opening, and thus effected a cure.* All the older surgeons, down to La Faye, Palfin,† and even Sabatier,‡ believed that wounds of the intestines never united, except through the intervention of the peritoneum, the omentum, or some of the neighboring viscera.

In mortification of the bowels, especially when occurring

* *Traité des Maladies du Canal Intestinal*, T. i, p. 66.

† *Anatomie Chirurgicale*, T. ii, p. 66.

‡ *Medecine Operatoire*, T. i, p. 33.

in small patches, the mode of reparation appears to be similar to that which takes place when a wound or puncture is left to itself. By the time the eschar is detached the edges of the breach will have formed adhesions to the circumjacent parts, by which the effusion of fæcal matter will be effectually guarded against. Where this is prevented the patient dies from peritoneal inflammation, or an artificial anus is established.

The subject of gunshot wounds of the intestines appears to have been more profoundly investigated by Baron Larrey than by any other surgeon. He divides the curative process into four stages. In the first, the bruised and lacerated tissues are deprived of their vitality, to an extent varying according to the amount of the injury they have sustained. In this respect a gunshot wound of the alimentary canal does not differ from that of any other part of the body. In the second stage, the eschar is detached, and the opening gives vent to fæculent and purulent matter, which continues to escape for several weeks or even months. During the third stage, the discharge gradually diminishes, and at last ceases altogether to appear externally. The union of the wound constitutes the fourth stage. The corresponding textures gradually approach each other, and, cicatrizing from within outwards, the whole chasm is at length completely filled up: the primitive adhesions become absorbed, and there only remains a slight contraction of the intestinal tube at the wounded part.*

When sutures are employed the mode of reparation is essentially alike, whatever may be their form. The inflammation which is lighted up induces an effusion of lymph, which is speedily followed by adhesion of the injured coil to the neighboring structures, among which it is sometimes completely burried. At other times no such adhesion occurs, but the affected part throughout the entire line of suture is coated

* Medico-Chirurg. Review, vol. xvi, p. 58.

with a layer of plastic matter, by which the continuity of the serous surface is finally re-established, and the threads used in sewing up the wound are concealed from view. In almost all cases—certainly in eight out of ten—there is an attachment of the omentum to the surface and edges of the wound, which thus assists, in an eminent degree, in the process of restoration. (Pl. fig. 5.) I speak now of course only of what I have noticed in dogs; whether the same thing takes place so readily, and to the same extent, in the human subject, my information does not enable me to determine. Probably it does not, as the epiploon is generally much smaller in man than in some of the inferior animals, especially in the canine races. The attachment of this membrane to the surface and edges of the wound is a very different matter, it will be observed, from the projection of it into the breach, in the manner pointed out and so strenuously insisted upon by Jobert. We have already seen that the latter is comparatively rare, while the other, on the contrary, is exceedingly frequent.

This extraordinary tendency to adhesion in the external surface and edges of the wound to the parts around it, is nothing more than what might be expected when we reflect upon the nature of the peritoneum, and its invariable disposition, when inflamed, to pour out lymph. But it is otherwise with the mucous membrane. Here the process of re-union is not only much slower but much less perfect; lymph is furnished very sparingly, or in quantities barely sufficient to fill the chasm between the margins of the wound; and, owing to the heterogeneous and irritating nature of the contents of the tube, a long time must necessarily elapse before it can become an organized or living intermedium. The little narrow band thus formed adheres firmly to the bottom of the wound, but very slightly, if at all, for some days, to its edges. Gradually, however, it becomes more and more dense; vessels extend into it from the circumjacent parts; its margins are flattened down; and, after a period varying from a few weeks to as many months, the adhesion is finally completed. Subsequently, or, indeed, while the changes just

adverted to are still in progress, the new matter is nearly all absorbed, the wound greatly diminishes in width, and when the cicatrizing process is perfected merely a small depression or seam remains, to indicate the original seat of the injury. The whole process may be compared to that which nature employs in the reparation of ulcers of the mucous lining of the small and large bowel. (Pl. fig. 6, 7.)

This, however, is only one mode in which the restoration of the mucous surface is effected. Another, though by no means a frequent one, is by granulation. It has been already stated that, owing to the irritating and heterogeneous character of the contents of the bowel, the lymph which is deposited upon the wound is very tardy in becoming organized, and it may now be added that this process is occasionally entirely prevented, the substance in question being either destroyed or removed by the fæcal matter as it passes over the affected part. When this happens, nature, faithful to her duty, makes an effort to repair the breach by the formation of granulations, as in similar injuries of other textures. The process under these circumstances is generally much more tardy than in the previous case, the cicatrization is also less complete, and the tube is much more apt to be puckered immediately around the seat of the injury. Mr. Travers seems to doubt that the fissure in the mucous lining is ever filled by granulation. "I had been led to expect," says he, "that the interstice of the villous coat would be filled by granulation, and that the substance of the cylinder would in this way be restored at the place of division. But finding the eversion of the villous edges uniform and permanent, it seemed doubtful if such a process could be set up, as perfect surfaces were opposed to each other. It is also not inconsistent with the indisposition of mucous surface to the adhesive inflammation to infer that it does not readily admit of the granulating process, which is only an advanced stage of that inflammation."*

* Op. cit., p. 131.

I quote the language of this distinguished author, in order that his meaning may be fully understood. I am not aware that a similar opinion has been expressed by any other writer, and how so accurate an observer should have arrived at so erroneous a conclusion cannot be easily conceived. That granulations are formed on mucous surfaces is a matter of daily observation, and my researches have abundantly satisfied me that they are occasionally concerned in the restoration of the villous portion of a wounded bowel. The process of course is difficult; it must be so from the very nature of the mucous tissue, indisposed as it is to pour out plastic lymph; but this does not prove that it may not take place.

This writer has made another remark, not less erroneous, in relation to this subject, when he asserts that the adhesion which takes place between the mucous surfaces within a few hours after their connexion by suture is in no instance permanent, but that it is destroyed by the retraction of the divided parts when the ligatures drop off. Such an occurrence does undoubtedly sometimes take place, but I have repeatedly observed the reverse, and there is reason to believe, judging from the results of my own researches, that this happens much more frequently than is commonly supposed. Several days, often as many as eight or ten, must of necessity elapse before the sutures are detached; a period which is more than sufficient, in the plurality of cases, for the agglutination of the villous lips of the wound by plastic lymph. The apposition of the parts, moreover, is eminently favored by the crippled and paralysed condition of the muscular fibres at the seat of the injury, and by the tendency of the mucous membrane to eversion at the moment of the accident.

From the foregoing observations it is evident that the process of re-union is the same, whether the bowel be encircled partially or wholly by a ligature, whether we employ the suture, or, lastly, whether the wound, provided it be not too ample, be entirely intrusted to the resources of nature. In each case the restoration is effected through the medium of plastic lymph, poured out as a consequence of inflammation,

and undergoing, sooner or later, a certain degree of organization.

The manner in which the ligatures are detached varies, as might be expected, according to the mode in which they are applied. Both in the interrupted and continued sutures, with their different modifications, the threads, provided their extremities are cut off close to the surface of the wound, invariably fall into the alimentary canal, along with the contents of which they are afterwards evacuated. This, indeed, may be laid down as an axiom, to which I saw no exceptions in any of my experiments, and which fully confirm, in this particular, as well as in many others, the researches of Smith, Thomson, Travers, and Cooper. The fact that the foreign body employed in making the suture is thus disposed of appears to have been first noticed, at all events hinted at, by Mr. Benjamin Bell in his *System of Surgery*; but it remained for two of the gentlemen whose names have just been cited, namely, Mr. Thomson and Mr. Travers, to settle the question by a direct appeal to experiments on the inferior animals.

The same circumstance, as was previously intimated, occurs when a ligature is cast around a loop of intestine, or when it is employed to encircle the margins of a small aperture, whether caused by injury or mortification. If, on the other hand, the extremities are permitted to hang out at the external wound, they will be discharged outwardly instead of inwardly, as in the former case. When the threads, through accident or negligence, slip beyond the reach of the operator, and escape into the peritoneal cavity, they will either induce fatal inflammation, or lymph will be poured out and they will thus become encysted, or they will excite ulcerative action in the coats of the bowel and find their way into it, or they will be evacuated through the opening in the wall of the abdomen.

CHAPTER II.

Of the Treatment of Wounds of the Intestines.

Having, in the preceding chapter, described the nature of wounds of the intestines, we come, in the next place, to speak of their treatment; a topic which necessarily involves the consideration of the suture in all its modifications and varieties. To exhibit this important subject in its true light, I shall treat it under the following heads:

First, Penetrating wounds of the abdomen unattended with protrusion of the bowels.

Secondly, Penetrating wounds with protrusion, but no lesion of the bowels and omentum.

Thirdly, Penetrating wounds with protrusion and injury of the bowels.

Fourthly, The therapeutic, or common local and constitutional means.

Fifthly, The treatment of wounds of the bowels by different kinds of sutures.

SECT. I.—*Penetrating Wounds of the Abdomen unattended with protrusion of the Intestines.*

In entering upon this subject, the first question that presents itself is, are there any circumstances in which the surgeon should feel himself justified in returning into the abdomen a wounded bowel without sewing it up? This is a point, it must be conceded, of paramount importance, since it closely concerns not only the reputation of the practitioner, but, what is of much greater moment, the fate of the sufferer.

Penetrating wounds of the abdomen are not necessarily attended with protrusion of the bowels. Far from it. It is well-known that serious mischief is frequently inflicted, and yet, owing to the small size of the external opening, to the position of the body at the time of the accident, or to some

other cause, there is not the slightest prolapse. In a case of this kind it does not matter, as a general proposition, what may be the extent or direction of the wound; whether, in other words, it be small or large, oblique, transverse, or longitudinal, since the treatment is to be conducted solely upon general principles, like that of any other internal or penetrating wound whatever. No probing is to be done, no dilatation practised, no suture employed. All that is required is to keep the patient quiet, and to resort to such means as are calculated to prevent inflammation, or, if this should arise, to limit its action. This is all that sound surgery demands, all that common sense indicates. Still, as there are no rules in grammar without exception, so there are very few, if any, in the healing art that do not admit of some deviation from established usages. This I believe to be eminently true in regard to the present subject. While, therefore, I would condemn as much as any one, and in language as emphatic as it is possible to express it, an indiscriminate recourse to the means just referred to, or avoid dilating the external wound and searching for the injured bowel, with the view of sewing it up, simply because the patient has been hurt, I believe that circumstances may occasionally occur in which such a practice would not only be proper, but highly necessary to the safety of the individual. Let us, for the sake of being more fully understood, suppose a case: A man, after having indulged in a hearty repast, receives a penetrating wound in the abdomen from the thrust of a dirk or knife; the bowel is pierced, or, it may be, nearly divided, and there is a copious discharge of fæcal matter, both externally and into the peritoneal cavity, as is evinced, in the latter event, by the excruciating pain, the gastric oppression, and the collapsed condition of the sufferer. Here the most prompt and decisive measures must be resorted to, or the person will perish from peritoneal inflammation with as much certainty as if his skull had been fractured and a portion of his brain let out. It will not do for the surgeon to fold his arms, and look upon the scene as an idle and uninterested spectator. Far otherwise

He has a duty to perform, and that duty consists in dilating the external wound, if it be not already sufficiently large, in hooking up the injured bowel, and in closing the solution of continuity with the requisite number of stitches, at the same time that the effused matter is carefully removed with tepid water and a soft sponge. All wiping must, of course, be avoided, as this would add much to the risk of peritonitis.

By the above procedure, which, under the circumstances pointed out, I should never hesitate to pursue, the patient is not placed in a worse condition than a female who has undergone the Cæsarian section, or a person whose abdomen has been ripped up in the first instance; recovery from both of which is not, as is well-known, of unfrequent occurrence. A case in which a most extensive wound of the belly, with complete division of the ileum, and serious lesion of the thoracic cavity, was successfully treated by Mr. Calton, of Scotland, is reported in the twelfth volume of the *Edinburgh Medical and Surgical Journal*, and another, in which still more frightful mischief was inflicted by a cannon-ball, and yet the man got well, is mentioned in *Hennen's Military Surgery*, and will be found in another part of this essay. A number of similar examples are scattered through the records of the profession, and could the experience of practitioners generally be ascertained in regard to this point it would be found, I doubt not, to afford a vast amount of additional evidence illustrative of this important subject. The truth is, the fatality of penetrating wounds of the abdomen has been greatly exaggerated. Injuries of this kind have been a sort of bugbear with surgeons and physicians, not so much from what they themselves have witnessed as from what they have heard from others; and hence a prejudice has arisen against the infliction of wounds and even punctures upon the peritoneum which has "grown with our growth and strengthened with our strength" until it has become almost impossible to eradicate it.

In making these remarks respecting the dilatation of the outer wound, for the purpose of enabling us to search for the injured bowel, let it be understood that I would recommend

the practice only under particular circumstances. These circumstances have been already pointed out, and it is not necessary, therefore, to dwell upon them in this place.

When there is reason to suspect, from the nature of the vulnerating body, that the opening in the intestine is comparatively small, not exceeding, perhaps, the third or fourth of an inch in diameter, it would be extremely improper, if not absolutely unjustifiable, to search for the bowel with the view of sewing it up. Such a step, indeed, could not be too strongly reprobated, as it would seriously complicate an injury which, if left to itself, might easily heal.

The above remarks, with the reasoning founded on them, are fully borne out, if I mistake not, by some of the facts cited in a previous part of this inquiry, in relation to the escape of fæcal matter from the alimentary canal, when laid open to the extent of from four to six lines, whether longitudinally, transversely, or obliquely. In all cases of this kind, with scarcely a solitary exception, death is produced in from thirty-six to forty-eight hours by peritoneal inflammation. Mr. Travers, with many other respectable surgeons, is, I am aware, strongly opposed to the practice of dilating the abdominal wound and searching for the injured bowel, on the ground that the intestinal aperture retains its apposition with the parietal orifice; but he has adduced no experiments, or facts of any sort, in support of his conclusion, which is, besides, at variance with the existing state of our knowledge in relation to the subject. My own researches, at all events, have led me to a different result, and I can therefore see no just reason why the suggestion which I have ventured to throw out should not be adopted under the restrictions indicated.

SECT. II.—*Penetrating Wounds of the Abdomen with protrusion simply of the Intestines and Omentum.*

The next topic into which I shall inquire is the conduct which the practitioner should observe when he is called to a penetrating wound of the abdomen, attended with protrusion,

but no particular injury, of a portion of the alimentary canal. Cases of this description are by no means unfrequent, and they occasionally happen when the external opening is so small as to render it seemingly impossible for any prolapsion to take place. By the older surgeons such injuries were often treated in the most barbarous manner, and it is not improbable that serious harm is sometimes done by the ignorant and timid in our own day. Instead of reducing at once the extruded intestine, a procedure sanctioned both by theory and experience, a great deal of time used to be wasted in fomenting the part, in the vain hope that this would promote recovery; and when at length, by the delay thus occasioned, the gut became too painful to be replaced, instead of dilating the outer wound, they did not hesitate to leave it in its exposed situation; a practice which, as might have been supposed, was speedily followed by the death of the patient, or, what is scarcely less pitiable, an artificial anus.

It is perfectly plain that in such a case the part should be at once restored, without the loss of a moment. It is certain that no good can be done by delay, while it is equally clear that it may be productive of much harm. Before the surgeon proceeds to the operation, the patient should be placed in the best possible position for relaxing the abdominal muscles. For this purpose he should lie on his back, the head being supported by a pillow, the pelvis elevated higher than the shoulders, and the lower extremities bent at the hips and knees. If the bladder be much distended, it should be previously emptied, and the patient should refrain from coughing, holding his breath, or any similar efforts calculated to impede the reduction. In a word, he should conduct himself precisely as if he were about to undergo an operation for strangulated hernia.

When these arrangements are effected, the surgeon, standing at the side of the patient that may be most convenient to him, takes the bowel into the left hand, while with the right he gently pushes it back, taking care to begin with the part which was protruded last, or which is nearest the wound.

These efforts are to be continued until the whole slips into the abdominal cavity, when the external opening is to be closed in the manner to be pointed out presently, and the case treated upon general principles. Proceeding slowly and cautiously in this wise, the largest protrusions may generally be replaced without much difficulty, without inflicting any undue violence upon the patient, or without endangering the result by peritoneal inflammation. Nevertheless, it is sometimes almost impossible to effect the reduction, even when the prolapsion is inconsiderable, owing to the smallness of the external orifice, to the distended condition of the bowel, or to the spasmodic action of the muscular fibres, or to all these causes combined. Be this as it may, the best method, under these circumstances, is to enlarge the wound to the requisite extent by means of a probe-pointed bistoury, cautiously insinuated between the gut and the resisting parts. Some of the older surgeons, as Paré, Low, and Garangeot, were in the habit, when the difficulty depended upon inflation, or gaseous distention, of making punctures in the bowel to evacuate the contained air; a practice which was afterwards embraced by Gooch, Sharp, Sabatier, Chopart and Desault. The plan, as originally suggested, consisted in making the punctures with a small needle, which was replaced by a large round one in the hands of Chopart and Desault, who have described the operation with much minuteness. The procedure, however, was pointedly condemned by Blancard and La Faye, on the very sufficient ground of its inefficacy, as well as danger, and is now scarcely ever thought of, except as a matter of scientific curiosity. Others have recommended the substitution of a small trocar, but the same objections lie against it as against the use of the needle.

In our attempts to restore the bowel to the abdomen, it is all important to know that it has actually slipped into its natural situation. The route which the wound follows is occasionally very devious, or it may happen that there is a slight detachment of the peritoneum round the edges of the inner orifice, produced either in the first instance, or by

the finger of the surgeon in his efforts at reduction. In either case, a most serious error may be committed by supposing that the protruded parts have been returned, when in reality they are retained on the outside of the serous cavity, where they may become strangulated, or affected with undue, if not fatal, inflammation. The operator should therefore never rest satisfied that the restoration has been accomplished unless he is convinced that the finger has been fairly within the abdomen, or in contact with the convoluted surface of the bowel.

Penetrating wounds of the abdomen are rarely unattended with some protrusion of the omentum. From the situation of this serous lamella, and from the manner in which it is spread over the surface of the bowel, it is indeed usually forced out first, and not unfrequently it is the only part prolapsed. However this may be, it should always be carefully returned, otherwise the greatest mischief is to be apprehended. A distinguished surgeon, Baron Larrey, has, it is true, advised us to let it alone, that is, neither to return it, nor to remove it by the knife or ligature; a practice recommended by some very eminent authorities. Soon after the accident, he observes, the extruded membrane swells, becomes thick and red, and assumes a rough, granulated aspect. These symptoms increase until the third day, after which they remain stationary for nearly a fortnight, when the part begins to shrivel, and is ultimately reduced without any operation.* Very few practitioners will, I presume, be disposed to follow this advice, which is, to say the least of it, singularly at variance with that of the best writers on penetrating wounds of the abdomen and the management of ruptures. That practice is undoubtedly the safest which most readily promotes the recovery of the patient, and that this desirable end is more promptly and perfectly attained by returning the whole of

* Medico-Chir. Review, vol. ii, p. 261. 1821.

the prolapsed omentum at once into the abdomen, than by allowing it to remain in the situation pointed out by the Baron, no one can doubt. Both experience and common sense are in favor of the course of treatment so long pursued by the ablest surgeons, and I can therefore see no necessity for adopting a new one, especially when that method is of an equivocal character. It is a good maxim in surgery, as it is in morals, to let well enough alone.

It need hardly be remarked that, when the protruded parts are covered with dirt, *fæces* and blood, or other extraneous matter, they should be carefully cleansed before any attempt be made to restore them to their natural situation. The importance of this practice is too obvious to require any comment. The best article for this purpose is tepid water, either alone or mixed with milk, applied by means of a sponge held some distance off. The stream thus produced is well calculated to detach the foreign substances, whatever they may be, without inducing any additional irritation. In no case should the parts be sponged or wiped, for reasons which it is unnecessary to specify. If the extraneous matter adhere with much firmness, it may be picked off with a pair of forceps, or some other instrument, and on no account should the bowel be replaced until it has been thoroughly cleansed.

Fomenting the extruded parts with infusion of chamomile flowers, oil, hops, or wine and water, as recommended and practised by the late Baron Larrey, can do no good, and ought to be avoided. The advice of the French surgeon, indeed, is decidedly objectionable, if not reprehensible. The abdominal organs are the best fomentors, and the sooner the protruded parts are brought into contact with them the better.

The omentum, when prolapsed along with the bowel, should always be reduced last, and care taken to spread it out as much as possible over the parts which it naturally covers. This can generally be easily done by means of the index-finger of the right hand introduced into the peritoneal cavity, and is calculated to prevent its subsequent protrusion

between the edges of the wound; a circumstance which almost constantly happens when this precaution is neglected.

In regard to the management of the external wound, it is obvious that it must be conducted upon the same general principles as that of a solution of continuity in any other situation. Sutures should never be employed, except where they are imperiously indicated. It should be remembered that they are foreign bodies, which can never be resorted to without an increase of pain, or without endangering the development of too much morbid action. It is well-known, too, that when introduced into tendinous structures they are apt to excite a bad form of inflammation, and that, if inserted into muscular parts, spasm and even convulsions may be the consequence. Nevertheless, cases often do occur in which we cannot dispense with them. The wound may be unusually large, or the patient so restless and unmanageable as to render it impossible to prevent a recurrence of the protrusion unless the parts be sewed up. Under circumstances such as these we would not only be warranted in employing the suture, but we should be justly culpable if we neglected it. Dogs bear this treatment with perfect impunity, and many cases are recorded in which it was advantageously employed in the human subject. In making a suture in this situation the needle should be carried through the lips of the wound within a line and a half or two lines of the peritoneum, and the requisite number of threads placed before any of them are tied, in order to avoid injury to the omentum. The ends are then cut off, and the approximation perfected by means of adhesive strips, the whole being secured by a compress and broad bandage carried two or three times round the abdomen. At the expiration of thirty-six or forty-eight hours the ligatures should be cut away, as the parts will have sufficiently united to render them unnecessary. When the wound is very extensive some surgeons prefer the quilled suture, as it is termed, but for this

there can seldom be any necessity, when the case is managed in the manner just mentioned.

SECT. III.—*Penetrating Wounds of the Abdomen with protrusion and injury of the Intestines.*

Penetrating wounds of the abdomen, attended with lesion of the intestinal tube, constitute a class of injuries of a much more serious character than such as are accompanied merely by prolapse. The symptoms are generally more severe, there is more danger of peritoneal inflammation, and the treatment, especially when the opening is extensive, is altogether different; or, to speak more intelligibly, two wounds, involving different structures, exist, and consequently require different modes of management.

When the inner wound is large the treatment to be employed is sufficiently obvious, for no well educated surgeon would hesitate to resort at once to the suture, or to some other expedient calculated to prevent fæcal effusion. It is only where the opening is small that doubts seem to be entertained respecting the proper course to be pursued.

Heister, who was confessedly one of the ablest anatomists and surgeons of his day, expressly states that all wounds of the intestines not exceeding the diameter of a goose-quill should be returned without stitching, which he asserts to be generally productive of severe pain, inflammation, and other bad symptoms.* Dionis says if the opening is very small, as, for example, when it is made by a bodkin or pen-knife, it is not necessary to sew it up; nature, seconded by a rigid diet, being fully competent to effect a cure.† To the same import very much is the testimony of Palfin,‡ and of Sabatier. The former of these authors observes that

* Travers, op. cit., p. 172.

† A Course of Operations, p. 53. English Edition, London, 1733.

‡ Anatomie Chirurg., T. ii, p. 76.

whenever the opening is diminutive it is not necessary to sew it up, but simply to return the part, and to restrict the patient to the smallest possible allowance of food, barely sufficient to prevent starvation. "If the wound," says Sabatier, "is very slight, as when only a few muscular fibres are involved, it is needless to resort to the suture, since a cure may be accomplished without it." Sharp, in his *Operations of Surgery*,* uses very nearly the same language. The opinion of Jobert, whose writings have been already several times quoted, is, that the wounded intestine may be safely returned, provided the opening does not exceed three lines. Where it is more extensive, as, for instance, half an inch, although reparation might possibly take place through the intervention of the epiploon, still there would be great danger of fæcal effusion, and hence he very justly concludes that it would be much better to sew it up.†

Richerand, also a modern writer, recommends a very different practice when the wound is very small, or does not exceed two or three lines.‡ His plan is to pass a loop of waxed thread through the mesentery, and to keep the inner wound as nearly as possible in apposition with the outer. The object is to afford a ready outlet to the fæcal matter, by the artificial anus which is thus established. This method, to which I shall hereafter recur, is not new with Richerand, but originated long ago with La Peyronie, an old French surgeon. Boyer remarks§ that when the wound is more than four lines in extent enteroraphy becomes indispensable.

In a preceding part of this essay—page 8—several experiments are related which have a direct bearing on this subject. The particulars, however, it is not necessary to reproduce in this place. It will be sufficient to say that in the

* P. 9. London, 1784.

† *Maladies du Canal Intestinal*, T. i, p. 72.

‡ *Nosographie et Thérapeutique Chirurg.*, T. iii, p. 319. Paris, 1821.

§ *Traité des Maladies Chirurgicales*, T. vii, p. 377. Paris, 1831.

three experiments in which the wound did not exceed four lines, or the third of an inch, the animals promptly recovered, while in the remainder, five in number, and in which the opening was of greater extent, they all died of fæcal effusion. So far, then as these researches go, they tend to confirm the opinion of Heister, Sharp, Garangeot, and others, that a protruded bowel, in which there is only a very small wound, may be safely returned into the abdomen, without any apprehension of the escape of alvine matter. But would the surgeon be really justified in pursuing such a practice? I unhesitatingly aver that he would not, for the reason that, although this course may, in the generality of cases, be attended with success, yet it is liable to occasional failure, and should therefore be discountenanced. The introduction of a suture, which is all that can be needed in a small wound, will assuredly add little either to the present suffering of the patient or to the danger of peritoneal inflammation; the operation is neither painful nor tedious, and, what is of far more consequence, always, when well performed, protects the individual from fæcal effusion. In several of my experiments death was produced, not from any undue injury inflicted upon the bowel from stitching or any rough manipulation, but from the interval between the sutures being so great as to prevent the perfect closure of the wound; a fact which should never be lost sight of in the management of a lesion of this kind. Whenever the contact is incomplete, the mucous membrane becomes everted, and interferes with the adhesive process. The more accurately this is obviated the less risk will there be of the escape of fæculent and other matter, calculated to induce fatal peritonitis. I do not care, therefore, how small the wound may be, if it is only a line and a half, or two lines in extent, it should by all means be sewed up. In this practice alone can there be perfect security for the patient. The villous membrane may, it is true, effect a temporary closure of the wound, but there is always danger that before adhesion

can take place, the part will become so much relaxed as to lead to mischief.

In closing this branch of the present inquiry I cannot omit quoting the sentiments of an old and distinguished surgeon, whose works, highly popular in their day, have been too much neglected by modern practitioners. I allude to Mr. Benjamin Bell.* “However small,” says he, “a wound of the intestine may be, it ought always to be secured with a ligature; for although it is alleged by some that we should rather trust to nature for the cure of a small opening than to insert a ligature, to me it appears that the opinion is by no means well-founded; insomuch that I would not leave even the smallest opening that could admit either fæces or chyle to pass, without stitching it up. Much danger may ensue from omitting it; and the hazard of the patient cannot be increased by the practice being adopted.”

Co-incident with this opinion of Mr. Bell is that of Mr. Lawrence, of London, whose views upon the subject are entitled to great weight, from the unusual opportunities which he has enjoyed for treating strangulated hernia. Adverting to the practice recommended by Jobert, and referred to in a previous paragraph, of replacing the bowel without suture, when the wound does not exceed three lines, he affirms that such a procedure would not only be hazardous, but unwarrantable in the present state of the science. “In case of such an opening in the intestine,” says he, “I should employ suture; not considering it safe to return the bowel into the abdomen without this precaution.”†

* A System of Surgery, vol. v, p. 281.

† Treatise on Ruptures, p 301. London, 1838.

SECT. IV.—*Therapeutic Means.*

It might be supposed that, in a treatise professedly devoted to the subject, considerable space would be allotted to the therapeutic treatment of wounds of the intestinal canal. Such a course would undoubtedly be highly proper, if not, indeed, indispensable, if these lesions involved any thing peculiar in this respect; but when it is remembered that they are to be managed upon the same principles as wounds in other parts of the body, much discussion of this kind would, to say the least of it, be irrelevant.

After the bowel has been restored to its natural situation, whether enteroraphy has been employed or not, the first and most important object is to guard against the occurrence of peritoneal inflammation, as it is upon this that the safety of the case mainly depends. Perfect quietude in the recumbent posture, the early and copious abstraction of blood, especially if the patient be plethoric, or the wound extensive, and the most rigid observance of the antiphlogistic regimen, are the means upon which our reliance is to be placed in the first instance. If the bowels be not evacuated spontaneously in six or eight hours after the parts have been returned, a stimulating enema should be thrown into the rectum, but under no circumstances should the alimentary canal be disturbed by the administration of purgative medicines by the mouth, as these, however mild, will be likely to cause griping pains and to interfere with the reparative process. This plan is to be persisted in for at least three or four days, when a dose of castor oil may be given, or, which would be better, an ounce of sulphate of magnesia or soda. The more fluid the alvine matters can be rendered the less likely will they be to be arrested at the affected part, to derange the sutures, or to disturb the healing process. All drastic articles must be sedulously avoided, on account of their tendency to create gastric irritation, and to excite undue peristaltic action of the bow-

els; two circumstances concerning which we cannot be too much on our guard.

The pulse should be attentively watched, and as soon as re-action is fully established, blood must be taken from the arm by a large orifice, and while the patient is in the semi-erect posture. The amount to be abstracted must vary according to the indications of the case, particularly the age and constitution of the individual, the return, continuance, or increase of the local pain, the force and frequency of the pulse, and the extent of the injury. The first bleeding ought, in general, to be tolerably copious, but after this eight or ten ounces at each repetition will be sufficient. In this way we prevent inflammatory action, or moderate it, where it has already taken place, without inducing too much prostration. It should be recollected that the pulse in peritonitis is hard, wiry, and contracted, and that the practitioner, if he be not fully aware of this, will be apt to fall into the error of omitting the abstraction of blood at a period when it is loudly called for, and when it can alone be of any avail in arresting the progress of the malady. General bleeding, however, is not always admissible. The shock which the system has received may be unusually severe; the reaction may be tardy and imperfect; and the patient may perhaps be for several days in a dosing state, with a weak and tremulous pulse, cold extremities, and great pallor of the countenance. In such a case, instead of taking blood from the arm, the practitioner must content himself with fomentations to the abdomen, consisting simply of warm water, or of water in which hops, opium, or poppy-heads have been infused, and frequently renewed. Even leeches are scarcely to be thought of. Where the stomach is irritable, mustard poultices are to be applied to the epigastric region; and if the patient is unable, as he occasionally is, to void his urine, it must be drawn off with the catheter. If cough be present, it is to be combated by the usual means, and not allowed to progress, as the concussion thus induced

might prove highly detrimental. When the patient is harassed with colicky pains, relief may be attempted by laudanum or the salts of morphia, but as the effect of these and similar articles is to create constipation, they should be employed as sparingly as possible. The tenesmus which is sometimes present is to be allayed by anodyne injections or suppositories; and where there is much discharge of blood from the bowels, the acetate of lead may be administered in large and repeated doses.

When there is much tumefaction of the abdomen with gastric irritability, and tenderness on pressure, Baron Larrey* advises cupping, aided by camphorated and oily embrocations, emollient cataplasms, and anodyne enemata. In a case, apparently of the most hopeless character, in which this practice was put in force, the disease yielded in a very short time, not, however, without vesication of the whole surface of the abdomen. With cupping I have no experience in the treatment of peritoneal inflammation, traumatic, or otherwise, but it seems to me that it would be attended with so much suffering to the patient as to preclude its employment in most, if not all cases of the kind. Leeching would certainly be preferable.

The diet must be of the most simple nature. For the first fortnight or three weeks, it should consist chiefly of amylaceous articles, as arrow root, tapioca or sago; afterwards it may be more nutritious, but must still be fluid. Solid, stimulating, or flatulent food is not to be used for several months after the accident. Two or three cases will hereafter be mentioned, where, from disregard of this precaution, the patient fell a victim to his imprudence, when he was apparently out of all danger. As a constant drink, nothing can be better than cold water, flax-seed tea, slippery-elm water, or a solu-

* Surgical Essays, translated by Dr. Revere, p. 235.

tion of gum-arabic, simple or acidulated. In a word, the patient should be half-starved, and as much depleted as is consistent with the restorative process. Our treatment must be prompt and energetic. No time is to be lost, or the case will slip out of our hands. The great error with most practitioners is that they do not abstract blood sufficiently early, or before peritoneal inflammation is thoroughly established, or has made such inroads upon the system as to render it impossible to arrest its progress.

When blood is extravasated in considerable quantity into the peritoneal sac, as is evinced by the soft and tremulous state of the pulse, the pallor of the countenance, the coldness of the extremities, and the constant disposition to swooning, the patient must be immediately placed in the recumbent posture, and made to take large and frequently repeated doses of the acetate of lead in union with opium. Mustard poultices should be applied to the hands and feet, and cloths, wrung out of cold water, to the abdomen, which is to be encircled at the same time with a broad bandage, to afford equable support to the viscera, and thereby promote the coagulation of the effused fluid. When there is reason to suspect that a large artery has been opened, the most effectual practice will be to cut down upon the parts, and secure it with a ligature. This procedure, however, has few advocates, and should only be employed as a dernier resort, not as a matter of choice. It would certainly be better to make an effort to save the patient by an operation, even of a desperate character, than to allow him to perish from the loss of blood, when the wounded vessel is within our reach.

The dressings must be light, simple, and unirritating. If there be a discharge of *feculent* matter, as there may be when the internal wound has not been properly sewed up, or even where there has been no protrusion in the first instance, it should be disturbed as little as possible, until there is reason to believe that the bowel has contracted firm adhesions to the surrounding parts. By disregarding this precaution fatal effects might ensue from the extravasation of the matter into

the peritoneal cavity. During the whole treatment the utmost attention should be paid to cleanliness. As the external opening diminishes, means are to be employed to prevent the escape of fæces, by which the patient will be rendered more comfortable, and the healing process expedited.

When the patient is well enough to sit up or walk about, the weakened parts should be supported by a compress and broad bandage, or, what is better, a good truss, which should be worn day and night, to prevent the separation of the edges of the sore, and the protrusion of the contents of the abdomen. This caution, as has been justly observed by Mr. Benjamin Bell, ought to be persisted in for a considerable time after the cure has been completed. By a want of attention to this point, very troublesome cases of hernia have occurred, which might otherwise have been obviated.

Patients who have recovered from wounds of this kind must pay particular attention to their bowels, which should be kept in a soluble condition, and on no account be allowed to be costive, even for a single day. They should also be extremely temperate in their diet, and carefully masticate their food before it is swallowed. All rough exercise, as riding on horse-back, jumping, running, and even rapid walking, must be avoided.

SECT. V.—*Treatment of Wounds of the Intestines by Different Kinds of Sutures.*

Having in the preceding pages discussed the nature, symptoms, mode of reparation, and therapeutic treatment of wounds of the intestines, I shall now proceed to speak of the different kinds of sutures. In studying this branch of the subject, the reader will be struck with the numerous and diversified expedients that have been devised for the management of this class of injuries.

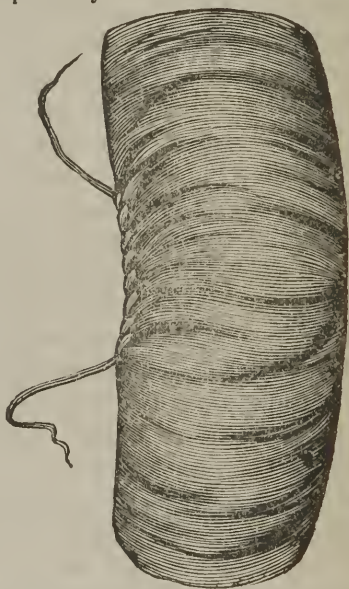
§ I.—*Continued Suture.*

The earliest suture employed for sewing up wounds of the intestines was the glover's, or, as it is generally termed by the French surgeons, the "suture du pelletier." It has also the name of the continued suture, and appears to have been extensively resorted to by the older surgeons in the management of common wounds. It was, however, long ago rejected in the treatment of injuries of this kind, and was for many years entirely abandoned even in cases of enteroraphy of the alimentary canal. Mr. Samuel Cooper, in speaking of this suture, observes that it may, in every point of view, be now considered as totally disused in every case of surgery which can possibly present itself. "When we remember," says he, "in making this suture, how many stitches are unavoidable; how unevenly, and in what a puckered state, the suture drags the edges of the skin together; and what irritation it must produce; we can no longer be surprised at its now being never practised on the living subject. It is commonly employed for sewing up dead bodies; a purpose for which it is well-fitted; but for the honor of surgery, and the sake of mankind, it is to be hoped that it will never again be adopted in practice."* How far this sweeping denunciation is entitled to consideration, we shall endeavor to show in another part of this inquiry; it is sufficient, at present, to say that the glover's suture has, in my judgment, been unfortunately too long neglected, and that, when judiciously employed, it is capable of affording the most happy results in the treatment of intestinal wounds, no matter what may be their situation, direction, or extent.

The glover's suture is usually executed with a straight, round needle, armed with a single waxed thread, which is carried from within outwards obliquely from one lip of the

* Dictionary of Surgery, vol. ii, p. 331. New York, 1836.

wound to the other, until the whole track of it is sewed up. The instrument should be introduced throughout at the same distance from the edge of the breach, and the intervals between each two respective stitches must not be too great for fear of fæcal effusion. The thread, moreover, must not be drawn too tightly, otherwise the lips of the wound will overlap each other and have a puckered arrangement; an occurrence which, as it is calculated to interfere with the adhesive process, should be scrupulously avoided. In performing enteroraphy, the older surgeons were in the habit of leaving at each angle of the wound a length of thread equal to about five inches, which was brought out at the external opening, where it was secured by a strip of adhesive plaster, or by a small compress and bandage. In about six days the ligature was generally sufficiently loose to be withdrawn, or, if it was still pretty tight, the attendant cut



it at the middle, and removed it by pulling gently at the ends. During this manœuvre great care was taken to give proper support to the external wound. As executed at the present day, the extremities of the suture are fastened either by a knot, or by passing them under an adjoining loop, after which they are cut off close to the surface of the bowel, into the interior of which the thread employed in the operation ultimately finds its way.

The experiments which I have performed to illustrate the use of the continued suture embrace the subject of transverse,

longitudinal, and oblique wounds, and amount altogether to seventeen in number. I shall detail them in the order in which they are here enumerated.

a.—*Transverse Wounds.*

EXPERIMENT I.—Transverse wound of the arch of the colon two inches in extent—continued suture—recovery.

After considerable difficulty I succeeded in drawing out of the abdomen a portion of the arch of the colon, into which I made a transverse incision two inches in length, and sewed it up with the continued or glover's suture. The dog was large, old, and made much resistance during the operation, which was attended with tolerably copious hemorrhage from the intestinal wound. The stitches were drawn very tight, to insure the more accurate apposition of the divided parts, and considerable violence was done to the omentum and surrounding structures, owing to the unusual restlessness of the animal. Notwithstanding this, he speedily recovered from the shock of the operation, was in excellent spirits the next morning, and had altogether a most rapid convalescence. On the eleventh day after the experiment he escaped from the room in which he was confined, as well, apparently, as if he had not been hurt.

EXPERIMENT II.—Transverse section of the ileum—continued suture introduced between the muscular and mucous coats—the animal killed on the twelfth day.

A tarrier was submitted to the same experiment as the preceding, with this difference, that the incision was made into the small bowel, and extended through the entire cylinder. The needle, moreover, was carefully conveyed between the mucous and muscular tunics, instead of through the whole of them, as was the case in the former operation. The wound was fourteen inches from the cœcum. The animal was permitted to live until the end of the twelfth day, when, the cure being considered sufficiently established, he was

killed. The small bowel and omentum were extensively glued together by plastic lymph, in a state of organization: the omentum projected into the outer, and adhered to the surface of the inner wound: the suture still retained its hold, though not every where in the same degree, and the villous edges were united by adhesive matter.

b.—*Longitudinal Wounds.*

EXPERIMENT I.—Longitudinal wound one inch long—continued suture—the animal killed at the end of two months and a half.

The subject of this experiment was a large dog several years old; he had fasted for twenty-four hours, and was perfectly well. The wound, one inch in length, was made along the convex surface of the ileum, a short distance from the cæcum, and sewed up with the continued suture with such firmness that nothing could escape through the interstices of the stitches. The day after the operation the animal was well, and continued so, eating and drinking with his accustomed avidity, until he was killed two months and a half after. The outer opening was perfectly healed with a portion of omentum in it. No adhesions existed between the bowels, or between these and the wall of the abdomen. Attached to the outer surface of the intestinal wound was a process of epiploon, which thus served to mark its situation, which it would otherwise have been difficult to detect, so complete was the reparation. The mucous part of the breach was beautifully cicatrized, a slight depression being the only thing out of the way, and the tube retained its normal dimensions throughout. Numerous tape-worms were seen in the small bowel. The various tissues and organs were loaded with fat.

EXPERIMENT II.—Longitudinal wound six inches in length—continued suture—the animal killed on the twentieth day.

The dog, as in the last experiment, was large and old. The

lower part of the ileum being withdrawn, I made an incision, six inches in length, along its convex surface, sewing up the whole of it with the continued suture. Considerable blood was lost during the operation, which was painful and protracted. The next day the animal was thirsty, looked stupid, and had occasional vomiting. Some blood, which had evidently proceeded from his wounds, was found on the floor of the room. On the third day he was quite cheerful, took some meat that was offered him, and from this time on he rapidly recovered. He was permitted to live until the twentieth day.

The outer wound was perfectly healed, with a small process of omentum intervening between its inner edges. The bowels were free from adhesions, except at the seat of the injury, where two folds were connected to each other and to a piece of the mesentery. On laying open the tube, a vertical fissure, three inches long by three lines in width at the middle, was discovered as the remains of the original wound. The bottom of the chasm was formed by a process of the mesentery, which was firmly attached to the exterior of the bowel, and exhibited a smooth, transparent appearance. The mucous lining was puckered, or thrown into numerous horizontal rugæ, like those of a ruffle, and along the edges of the fissure it was rounded off, elevated, and somewhat irregular. The caliber of the intestine was nearly a quarter of an inch wider than above and below the wound. All the other viscera were healthy, and the animal was in good condition. Every trace of suture had disappeared.

EXPERIMENT III.—Wound two inches long—continued suture—the everted mucous membrane pared off—the animal killed at the end of the third month.

The dog, the subject of this experiment, had fasted for twenty-four hours; he was small and several years old. The wound, situated five feet and a half from the ileo-cæcal valve, was two inches long, and united with the continued suture, the stitches being so near each other as to leave no chance for the escape of any thing through their interstices. The

everted mucous membrane was carefully pared away, and the whole returned in the usual manner. The recovery was rapid, and three months after the operation the dog was killed. The suture, indeed every trace of it, had disappeared, the breach being thoroughly repaired, and the continuity of the villous membrane re-established. A small process of the omentum adhered to the surface of the affected intestine, and another projected into the outer opening, but was in progress of absorption. The caliber of the tube was in no wise diminished. No adhesions existed between the different convolutions.

EXPERIMENT IV.—Longitudinal wound two inches in length—continued suture—the everted mucous membrane pared off—the animal killed at the end of a month.

The dog was small and about eighteen months old; the wound, situated within a short distance of the ileo-cæcal valve, and two inches in length, was closed in the same manner as in the preceding experiment, and the everted mucous membrane pared off on a level with the serous surface. The animal had been fed a few hours previously, and vomited several times immediately after he was removed from the table. The next day he appeared comfortable, and quarrelled with his comrades for his part of the rations. On the 21st of September, precisely one month after the operation, being rather lean, but in good health, he was killed. The omentum, as in the preceding case, adhered to the small bowels, and a process of it was prolonged into the outer wound, which was perfectly healed. There was no appearance of recent peritonitis; a part of the ligature employed in making the suture was still retained, but the wound was beautifully cicatrized, and the cure completely established. The caliber of the tube was natural.

EXPERIMENT V.—Longitudinal wound two inches long—continued suture with the everted mucous membrane pared off—the animal killed on the twenty-eighth day.

This experiment, as well as the next two, was merely a repetition of the preceding. The wound, situated four feet from the ileo-cæcal valve, was of the same length and treated precisely in the same manner, the everted villous membrane being cut off close to the peritoneal surface. The animal, small and rather young, was in good condition when he was killed on the twenty-eighth day. The post-mortem appearances did not differ materially from those observed in the preceding case. The outer wound was healed with a piece of omentum in it, and the inner was also nearly repaired, but the suture was only partially detached, being retained by a small slip of mucous membrane. There was no adhesion between the folds of the intestines, or between these and the wall of the abdomen, nor any contraction of the caliber of the tube. In short, the cure was complete.

EXPERIMENT VI.—Wound two inches long—continued suture—the everted mucous membrane pared off—the animal killed on the twenty-eighth day.

The subject of this operation was a small young slut; and the wound, not quite two feet from the ileo-cæcal valve, was treated as in the two last experiments. The next day a large piece of omentum, dark, bloody, and covered with dirt, was found protruding from the external wound; it was immediately encircled with a ligature, and excised. The animal, notwithstanding this untoward circumstance, speedily convalesced, and was allowed to live until the twenty-eighth day, when she was killed. The internal wound was nearly healed, but a part of the suture still remained, a few of the stitches not having ulcerated away. The larger part of the thread was lying loose in the bowel, incrustated with solid fæcal matter. The whole would probably have been detached in a few days. The small bowels were slightly united to each other

and to the omentum by plastic lymph, and the outer wound was thoroughly cicatrized. The animal had not lost any flesh from the effects of the operation.

EXPERIMENT VII.—Wound two inches and a half long—continued suture—the everted mucous membrane pared off—the animal killed on the tenth day.

The dog was large, several years old, and had fasted twenty-four hours. The wound, situated along the convex surface of the ileum, within two feet of the cæcum, was two inches and a half long, and closed as in the preceding experiments, the mucous membrane protruding through the interstices of the stitches being carefully pared away on a level with the serous surface of the bowel. About five ounces of blood were lost during the operation, which was somewhat protracted, owing to the inordinate resistance of the animal. The bleeding had not ceased when the bowel was returned. No untoward circumstance occurring, and the cure being considered established, the dog was killed on the tenth day. A large plug of omentum filled the external wound, the edges of which were already firmly united. The small bowels were extensively adherent to each other and to the epiploon; the suture retained its hold throughout the greater part of its extent, and a layer of lymph occupied the interval between the villous margins of the breach. The tube at the seat of the injury contained fecal matter, and presented no contraction. The marks of acute peritonitis which generally supervenes upon a lesion of this kind, had entirely disappeared; or, rather, no more inflammation had existed than was necessary to effect the reparation.

EXPERIMENT VIII.—Wound one inch long—continued suture introduced between the mucous and muscular tunics—the animal killed on the fifteenth day.

Wishing to ascertain whether the edges of the wound could not be more perfectly approximated by carrying the needle between the muscular and villous tunics, or, in other words, through the cellulo-fibrous lamella, described in a previous part

of this essay, I instituted this and the following experiments.

Drawing a loop of the ileum from the abdomen of an old tarrier, I made a longitudinal incision, one inch in length, along its convex surface, not far from the cœcum, and sewed it up by carrying the needle, as just intimated, between the villous and muscular tunics. As had been anticipated, my expectations were not disappointed. The operation, without being more painful or protracted than when executed in the ordinary manner, had the effect of bringing the surfaces of the incision into the most perfect apposition. No severe indisposition followed, and the animal was permitted to live until the fifteenth day, when he was killed and his body carefully inspected. On laying open the bowel, which was closely attached to two adjacent coils, as well as to the omentum, the suture was found to be only partially detached, and to be incrustated with small nodules of fœcal matter. The continuity of the villous surfaces was re-established through the medium of a thin, narrow band of lymph, which was removed by maceration for two days in water. There was no abnormal redness either in the mucous or in the serous coat of the bowel, nor any contraction of its caliber. The continuity of the serous lips of the wound was unusually perfect. The outer opening was healed, a process of omentum being prolonged into it.

EXPERIMENT IX.—Wound one inch and a half long—continued suture introduced through the cellulo-fibrous lamella—the animal killed at the end of the thirty-fifth day.

The subject of this experiment, a large dog, several years of age, had fasted for twenty-four hours. The wound, occupying the inferior extremity of the ileum, was eighteen lines in length, and closed precisely as in the preceding experiment. The animal vomited several times within a few minutes after the operation, and appeared considerably exhausted. The next morning, however, he had recovered his wonted activity and cheerfulness, and rapidly convalescing, remained in good health until the thirty-fifth day, when he was killed.

The dissection revealed the following appearances. The outer wound was perfectly healed, and there was no adhesion between the bowels, or between these and the omentum, except immediately around the seat of the injury. No trace of suture was discovered; the villous edges had a rough, granulated aspect, and were united in the greater part of their extent; the wound was scarcely an inch long; the mucous membrane was free from inflammation; and the canal was of the normal dimensions. The dog was rather lean. All the other abdominal viscera were sound.

EXPERIMENT X.—Wound three-quarters of an inch long—continued suture introduced through the cellulo-fibrous lamella—the animal killed at the end of thirty hours.

The animal was a small but full-grown slut. The wound, situated in the ileum, eighteen inches from the ileo-cæcal valve, was nine lines in length, and closed in the same manner as in the last two experiments. The animal did not seem to mind the operation, and was well up to the moment she was killed thirty hours after. The object I had in view in destroying her so soon, was to ascertain the progress which nature had made towards reparation. The outer wound, closed by a plug of omentum, was feebly united by adhesive matter. Three knuckles of the small bowel were agglutinated by plastic lymph, of moderate firmness, with here and there a small ecchymotic speck. The epiploon covered the outer surface of the intestinal wound, and had a red, inflamed appearance for some distance around it. The edges of the villous membrane were of a pale lilac color, flat, and separated only by a very narrow, thread-like band of adhesive matter. There was no contraction of the bowel at the seat of the lesion, and no obstruction to the passage of fæcal matter. A drawing of this specimen was made immediately after it was examined. It was then immersed in dilute alcohol, which had the effect of depriving it, in twenty-four hours, of its red color, and of detaching the effused lymph.

EXPERIMENT XI.—Wound one inch long—continued suture introduced through the cellulo-fibrous lamella—the animal killed at the end of the fourth day.

Anxious to investigate this point a little further, I repeated the last experiment upon a large dog laboring under an attack of mange. He had fasted for eighteen hours, and bore the operation without a struggle. The wound was twelve lines in length, and situated in the inferior extremity of the ileum, within eleven inches of the cæcum. At the end of the fourth day, without apparently suffering from the effects of the operation, he was killed. The edges of the outer opening were pretty firmly united by adhesive inflammation with an intervening process of omentum. The omentum also adhered to the intestinal wound, as well as for a short distance around it; and the injured part was firmly glued to a neighboring convolution. The lymph which served as the connecting medium was of good firmness, and exhibited all the phenomena of incipient organization. The wound itself was reduced to nearly one-half its original length, and the edges, of a pale rose color, were separated by a thin narrow band of adhesive matter. The villous membrane presented no unnatural redness, nor was there any inflammation of the omentum, except in the immediate vicinity of the injury. No obstruction existed to the passage of the fæces.

EXPERIMENT XII.—Wound one inch long—continued suture carried through the cellulo-fibrous lamella—the animal killed at the expiration of forty-eight hours.

The subject of this experiment was a small young slut, four or five months old, which had been fed only a short time before the operation. The incision, an inch long, was made in the lower part of the small bowel, and approximated by the continued suture. She was killed at the expiration of forty-eight hours, having been previously in good spirits. The outer wound was somewhat tumid and but feebly united, a plug of omentum projecting into it. This apron-like membrane had likewise contracted extensive adhesions to the

surface of the small intestines, and exhibited all the evidences of high inflammation. The affected cylinder was intimately connected to the adjacent knuckles by plastic lymph, containing a number of small bloody depôts, and readily yielding under the pressure of the finger. On breaking up these adhesions the serous lips of the wound were found to be in close contact with each other, and to be thoroughly coated with the substance just mentioned. The villous edges were of a deep rose color, as was also the mucous surface for some distance above and below, and the ligature retained its situation throughout the whole line of suture; scarcely any lymph intervened between them, and they were perfectly smooth and regular. The bowel was not contracted or diminished in size.

c.—*Oblique Wounds.*

EXPERIMENT I.—Wound one inch long—continued suture introduced through all the tunics, except the serous—the animal killed at the end of the tenth day.

A small, full-grown dog, which had previously fasted, formed the subject of this experiment. The wound occupied the convex surface of the small intestine, three feet from the ileo-cæcal valve, and was closed by the continued suture, the needle being carried through all the tunics, excepting the outer. By this management the serous surfaces were brought into pretty close contact with each other. No untoward symptoms occurring, and the cure being considered established, the dog was killed at the end of the tenth day. The small bowels were extensively connected to each other, as well as to the omentum, and no little difficulty was experienced in finding the wound. The suture still retained its place, except at one extremity of the breach, where it was detached, and hung loose in the canal. The villous edges were somewhat rough and elevated, and intervening between them was a small, narrow band of lymph, interrupted at several points of its extent; the affected part of the tube was

of the natural dimensions; the abdominal wound was only partially healed; and a process of epiploon projected into it.

EXPERIMENT II.—Wound of the ileum three-quarters of an inch long—continued suture introduced through the cellulo-fibrous lamella—recovery—the dog killed on the twenty-second day.

The wound in this experiment was three-quarters of an inch long, and closed by the continued suture introduced through the substance of the cellulo-fibrous lamella. Its distance from the ileo-cæcal valve was about three feet. The dog, which was young and of middle size, made considerable resistance during the operation, which had the effect of producing some exhaustion, followed by vomiting immediately after he was removed from the table. The next day he was dull and drowsy, but from this time he gradually recovered, and lived until the twenty-second day, when he was killed, being fat and healthy. The small bowels were adherent to each other and to the omentum, but not in so great a degree as in the preceding case. A delicate process of the omentum was attached to the intestinal wound, the villous margins of which were in close contact with each other, their continuity being quite perfect at several points. The suture had ulcerated away, except at the upper angle of the wound, where it still retained a feeble hold. The bowel was of the normal size, and contained semi-fluid fæcal matter. The abdominal opening had healed without the intervention of the epiploon.

EXPERIMENT III.—Wound one inch and a half long—suture introduced between the muscular and mucous tunics—recovery—the animal killed on the seventeenth day.

A fold of the small bowel having been drawn from the abdomen of a large dog, twenty hours after he had taken food, an incision, one inch and a half in length, was made along its convex surface, and the edges approximated as in the last experiment. The animal bore the operation without much resistance, and experiencing no ill-effects from it, he was

killed on the seventeenth day. The appearance revealed on dissection did not vary materially from those in the preceding cases. The external orifice, only partially cicatrized, had a plug of omentum in it, and this membrane also adhered, though not extensively, to the convolutions of the small intestines. The wounded portion of the tube had contracted very firm adhesions to the mesentery, which thus served to re-establish its continuity. The villous margins, rough and slightly elevated, were in intimate apposition with each other, but the adhesion between them was easily destroyed, except at one point, where the connecting medium was more dense and more completely organized. The breach was not more than thirteen lines in length, unaccompanied, however, with any sensible puckering of the mucous membrane, or diminution of the caliber of the affected cylinder. The suture was loosened in the greater part of its extent, but only partially detached.

The results of these experiments are eminently favorable to the use of the contined suture, as not one proved fatal, although the wounds in several were of extraordinary length.* In eight the needle was carried through the whole thickness of the bowel, and in five, the everted mucous membrane was pared off on a level with the surrounding surface; in eight, the suture was introduced through the fibrous lamella, or between the muscular and mucous coats; and in one, through all the layers of the tube, except the peritoneal. It is worthy of remark that the caliber of the tube was not sensibly diminished by the operation in any of the experiments.

Of these three methods, that of introducing the suture through the cellulo-fibrous lamella is the least objectionable, as it enables us to bring the serous surfaces into more accurate apposition. When the needle is conveyed through all the tunics, there must necessarily be some degree of pucker-

*It is proper to state that three of the animals were killed too soon after the operation to render it at all certain that they would have recovered from the effects of it.

ing, whereby the mucous lining will be forced between the lips of the wound, if not beyond the level of the peritoneal membrane. By such an arrangement the adhesive process would be retarded, and if the stitches were to lose their hold, or if the bowel should not become glued to the neighboring parts, fæcal effusion might occur, followed by its whole train of evil consequences.

In making the continued suture I would, therefore, recommend that the needle be carried through the cellulo-fibrous lamella, or between the muscular and mucous membranes, and not across all the tunics, as is generally advised by authors. The lips of the wound should be held parallel with each other during the operation, and the stitches, drawn with considerable firmness, should not be more than a line, or, at farthest, the eighth of an inch apart. The needle is to be introduced a short distance, say half a line, from the peritoneal edge of the opening,* and brought out at the corresponding point on the opposite side. The first stitch should be one line from one angle of the wound, and the last about the same distance from the other, care being taken to secure each with a double knot, and to cut off the extremities of the suture close to the surface of the tube. The instrument which I prefer, and which I employed in nearly all my experiments, is a long, slender sewing needle, armed with a waxed and strong but delicate silk thread. The operation should be performed as expeditiously as is consistent with safety, and the bowel handled in the gentlest possible manner.

Mr. Travers, to whose name I have already so frequently referred, and who is one of the most able and influential advocates of the glover's suture, performs the operation with

* It should be recollected that in wounds of the bowels there is always considerable retraction of this membrane, by which the other tunics are exposed. Hence if the needle be introduced half a line behind the peritoneal edge of the opening, as recommended in the text, it will be at least the eighth of an inch from the mucous margin, and this will afford the surgeon a sufficient amount of substance to prevent laceration, or breaking away of the stitches.

a small round sewing needle, armed with a silk thread, and passed near to the lines formed at the bases of the everted lips. The thread is carried at short and regular distances through the whole extent of the wound, the surgeon being mindful that an equal portion of the edges is included in each stitch. When the suture is finished, the ligature is securely fastened, and cut close to the knot. The reduction of the prolapsed fold, he adds, should be conducted with the nicest caution; and he recommends that the outer wound should be treated with a stitch, a plaster, or a poultice, as circumstances may dictate.*

In the management of injuries of this kind, Mr. Travers strongly insists upon the three following points; first, the accurate closure of the intestinal wound; secondly, the careful reduction of the protruded part; and thirdly, the union of the divided integuments. The treatment of the two wounds is thus made perfectly distinct, the internal suture falls into the bowel, and the whole process is materially simplified.

Another advocate of this suture, of no mean authority, was the late Baron Larrey, † whose experience was perhaps more extensive than that of any other surgeon that ever lived. His opportunities for treating wounds of the bowels in the human subject were unusually great, and he likewise performed a considerable number of experiments upon the inferior animals. After having made one or more incisions into the alimentary tube, in different directions, and in dogs of different ages, he united their edges by means of the "suture du pelletier," with the precaution of making it double, using alternately threads of different colors. He directs that the threads should not only be waxed, but anointed with mild cerate, to facilitate their introduction, and that they should be of sufficient length to be left hanging out of the abdominal wound. He advises that they should not be removed before the seventh day, and in some cases not even before

* Op. cit., p. 138.

† Surgical Essays, translated by Dr. Revere, p. 233.

the ninth. To extract them, it is only necessary to draw them gently in opposite directions, which may be easily done, as they are of different colors.

Sir Astley Cooper also speaks * favorable of the continued suture; but, like Larrey, he directs the end of the thread to be brought out at the external orifice, which is to be closed with great care. He thinks that cutting off the ligature near the bowel has a tendency to add to the danger of the patient, especially when there is a deficiency in the adhesive process; an opinion for which there is no just ground.

Mons. Velpeau † likewise prefers this suture, of which he has lately suggested the following modification:—In performing it, says he, the needle is carried obliquely downwards from the upper end of the gut over the outer surface of the lower, from which it is returned to within a line or two of the starting point, passed again to the lower lip, then back to the first, and so on alternately until it has traversed the whole track of the wound. To complete the operation nothing more is necessary than to draw in opposite directions the ends of the ligature, one of which will be at the origin, the other at termination of the suture. The object of this traction is to invert the edges of the wound and bring the serous surfaces into contact, but as this does not always answer, it may be proper to use a probe or catheter. The operation is finished by making a double knot. In mortified hernia, the ends of the thread, or even one of them, would be sufficient for retaining the bowel behind the ring, supposing it was not desirable to let it slip into the belly; and in this event the knot would also be unnecessary.

I shall conclude this subject with the following cases, which, so far as I know, are the only ones in which the continued suture was employed in the human subject, or, rather, in which the particulars have been communicated to the pro-

* Lectures, by Tyrrell, p. 497.

† *Medicine Operatoire*, T. 4, p. 138.

fession. From the antiquity of the operation, however, there can be no doubt that it has been often resorted to by practitioners, and it is to be regretted that our information respecting it is so limited.

CASE I.—Two perforations of the ileum with a knife—protrusion of the bowel—each opening closed with a continued suture—recovery in five weeks.*

Antonia Josie da Costa was stabbed, on the 3d of August, with a knife in the right hypogastric region, about three fingers' breadth above the pubic bone, the wound in the peritoneum being about nine lines in length. Through this opening a portion of the ileum protruded about ten or twelve inches, and presented two apertures opposite each other large enough to admit a finger. After clearing away the grumous blood, Mr. Peter Travers, a surgeon of Lisbon, who attended the case, closed each perforation with an uninterrupted suture, the ends of which were brought out at the external wound, which was sewed up in the usual manner. During the first four or five days after the accident, the man had severe pain in the abdomen, high fever, frequent vomiting, and hiccough. By repeated bleedings and clysters these symptoms gradually subsided, and towards the end of the fifth day he had a natural alvine evacuation. The internal sutures came away spontaneously on the twelfth of August, and on the seventh of September the patient was discharged in good health, the outer wound being entirely cicatrized.

CASE II.—Wound of the colon attended with the escape feces—patient eighteen years of age—continued suture—recovery.

This case is reported by Glandorpius,† an old surgeon, but it is deficient in some important details, a circumstance which detracts considerably from its value. The patient was a young

* The Philosophical Transactions of the Royal Society of London, abridged, vol. xi., p. 73.

† Speculum Chirurg. Obs., 34—Travers, op. cit., p. 163.

man 18 years of age, and the wound, the size of which is not stated, occupied the colon, and permitted the fæces to escape externally. Glandorpius employed the glover's suture, and although the symptoms were for sometime of a very unpromising character, complete recovery ensued. In another case, in which the wound implicated the ileum, and was plentifully besprinkled with an astringent powder, the patient died of gangrene on the fourth day.

CASE III.—Two transverse wounds of the small bowel—continued suture—attachment of the mesentery to the outer opening by two ligatures—recovery in thirty-six days.*

An Austrian soldier, in a scuffle with one of his comrades, was stabbed with a knife in the right side of the abdomen, about an inch above the umbilicus. The wound was transverse, about three inches long, and gave vent to a very considerable quantity of the small intestines. The patient being immediately conveyed to the Hotel-Dieu at Châlons-sur-Marne, Mons. Charliar, the surgeon-in-chief, discovered that the protruded gut was divided in two places; at one, in about one-half of its circumference, and at the other, about one-fifth. Passing a loop of thread through the mesentery behind each injured knuckle, he sewed up the wounds with the continued suture, and returned the whole into the peritoneal cavity. The two sutures were maintained near the edges of the outer opening, by means of the threads in the mesentery, which were fastened by an appropriate bandage to the surface of the abdomen. Emollient fomentations were applied to the belly, and the patient was kept in the semi-erect posture by pillows placed behind his back. For a month the most rigid regimen was observed. The ligatures were withdrawn at the end of a few days, as soon as it was found that the intestine had contracted firm adhesions to the inner surface of the wall of the abdomen. The outer

* Dictionnaire des Sciences Medicales, T. 43, p. 48.

wound cicatrized rapidly, and the patient left the hospital perfectly cured on the thirty-sixth day.

CASE IV.—Large sabre wound of the ileum—extensive protrusion of the small bowel—escape of stercoraceous matter—patient twenty-three years of age—continued suture—complete recovery in less than seventy days.*

The subject of this case was John Baptist Jolin, about twenty-three years of age, a fusileer in the sixteenth regiment of the guard. While playing with one of his comrades, he fell by accident upon the point of his sabre, which he held unsheathed in his hands, and which made a deep wound in the abdomen. He was carried to the neighboring village of Pucteau, where Mons. Carré sewed up his wounds. The external opening, about fifteen lines in extent, occupied the lower part of the right side of the abdomen, and gave vent to a large portion of the ileum which was already tumefied. "I examined the protruded bowel," says Mons. Carré, "and found a large wound, attended with a discharge of stercoraceous matter, which obliged me to make a suture at this point, immediately after which I returned the intestine into the cavity of the abdomen, dressed the parts, and sent the patient to the Hospital of the Guards at Paris." During the journey, which was tedious, he vomited copiously, and had one bloody stool.

On removing the dressings, immediately after his arrival in Paris, a portion of the small intestine, which had become prolapsed during the journey, and presented a swollen appear-

* I am indebted for this and the following case to Baron Larrey. The first is recorded in his *Surgical Essays*, edited by Doctor Revere; the other in his *Memoirs of Military Surgery and Campaigns of the French Armies*, translated by Dr. Hall of Baltimore, (vol. ii. p. 387.) Although it is not positively stated that the suture employed in these cases was the continued, yet there is strong reason to believe that it was, both from the size of the wound, the nature of the operation, and the decided preference which he has expressed for this method in different parts of his writings.

ance, was returned into the cavity of the abdomen without much effort. The patient, however, was not relieved. He was extremely weak and anxious, and had frequent vomiting of bilious matter, accompanied with violent colicky pains, tenesmus, and small bloody stools. On visiting him in the morning, Baron Larrey unbound the wound of the integuments and the opening made by the sabre in the aponeurosis of the great oblique muscle, when he discovered that a considerable quantity of blood had been effused into the peritoneal cavity, and that several of the convolutions of the intestines had already become united to each other. He therefore contented himself, although the symptoms of strangulation still remained, with evacuating the extravasated fluid, and dressing the wound with a linen rag, spread with styrax ointment, the whole being secured by a suitable bandage.

For thirteen days the symptoms were of the most violent character, and the patient was only saved by repeated dry and wet cupping of the abdomen, followed by camphorated embrocations and anodyne cataplasms, and finally by the application of blisters, with the use of enemata and the most rigid abstinence. At this period a small ligature, about three inches and a half long, was discharged through the external wound, and there was immediately a striking amelioration of all the symptoms. The patient grew better and better; the wound of the abdomen soon cicatrized; and in less than seventy days from the accident he was completely cured.

CASE V.—Two sabre wounds in the colon—extensive division of the mesentery—hemorrhage into the peritoneal sac—continued suture with the ends brought out at the abdominal opening—death on the seventh day from inflammation and gangrene of the peritoneum and intestines.

A grenadier was wounded with a sabre in a duel, on the right side of the umbilical region. A considerable portion of the small bowel protruded across the opening, and presented a reddish brown appearance; it was inflated, and contained a collection of worms. The patient suffered much pain

and distressing anxiety; the pulse was small and thready; the countenance ghastly; and the extremities cold. In this state he had been seven hours when he was brought to the hospital. Baron Larrey immediately dilated the abdominal opening, to relieve the strangulation, and to examine the other portions of the tube to see whether it was injured. He found the small curve of the colon wounded in two places, and the mesentery extensively divided by the sword. Having extracted the worms, which were still alive, with a pair of dressing forceps, he introduced a suture through the lips of the wounded intestine, and after bathing it with warm wine, reduced it, taking care to retain the ends of the thread on the outside. A considerable quantity of black clotted blood escaped at this stage of the operation, showing that effusion of this fluid had taken place in the abdomen. The lips of the external wound were approximated by a compress and roller. The patient was conveyed to bed, and took two grains of opium in sweet wine, which allayed his suffering and promoted reaction. The next day the abdomen was painful and tender to the touch; the urine was suppressed; the skin hot, and the thirst urgent. The edges of the outer wound had separated, but presented nothing remarkable. He died on the seventh day from inflammation and gangrene of the peritoneum and intestines.

On dissection the portion of bowel, formerly protruded, was found nearly of the natural appearance. The edges of the inner wound were agglutinated to each other, while those of the mesentery lay in folds, being united by adhesive substance, so that it was impossible for any alvine matter to escape into the peritoneal sac. The pelvis and interstices of the viscera were occupied by black and decomposed blood. Extensive adhesion existed among the different organs; the lower part of the ileum was sphacelated at several points; and the superior mesenteric artery was divided near its origin. But for the latter injury, it is highly probable, as has been remarked by Baron Larrey, that the man might have survived the wounds in the intestines, and finally recovered.

2.—*Interrupted Suture.*

It is not easy to determine, at this remote period, when, or by whom, the interrupted suture was first introduced to the notice of the surgeon. There can be no doubt, however, that it has been in use almost from time immemorial. The manner of performing it is too well known to require any mention in this place. The following experiments and observations will sufficiently illustrate the value of this suture in the treatment of wounds of the intestines. The former are arranged, in reference to their direction, into three classes, namely, into transverse, longitudinal, and oblique.

a.—*Transverse Wounds.*

EXPERIMENT I.—Complete section of the small bowel—four interrupted sutures—the ends of the threads cut off at the knots—death from peritoneal inflammation in forty-five hours.

Having opened the abdomen of a large dog after he had fasted for twenty-four hours, I drew out a fold of the small bowel by means of a blunt-hook, and divided it as far as the mesentery. The edges of the wound were then brought together by four interrupted sutures, placed equidistant from each other, and the ends cut off close to the serous surface. The whole being returned into its natural situation, the outer opening was united by two stitches, and the animal allowed water but no food. The operation was performed at eleven o'clock in the morning. In the afternoon the dog was sick at the stomach, threw up water several times, and lay quietly on his side. His thirst was not urgent, nor did he seem to suffer much pain. The next day he was dull and heavy, with occasional vomiting; his breathing became short and laborious, and he died in a state of coma forty-five hours after the experiment.

The following appearances were observed on dissection.

A process of omentum, very red and slightly adherent to the surrounding parts, projected into the outer opening, the edges of which were united by lymph. The peritoneal sac contained a pint of sanguinous fluid, and was universally inflamed. Three knuckles of the small bowel adhered to each other, and the wound was every where covered with plastic lymph, except at one point, three lines long, where the closure was imperfect, and where there had evidently been an escape of alvine fluid. The mucous membrane at the wound was slightly everted and rounded off, and exhibited all the evidences of high inflammation. The bowel above the seat of the injury was obstructed with fæcal matter, of a solid nature, produced apparently by a palsied state of the muscular fibres, and not by any contraction of the canal.

EXPERIMENT II.—Section of the entire cylinder of the bowel—seven interrupted sutures—recovery—the animal killed on the seventeenth day.

A small slut was submitted, September 4th, to the same experiment as the preceding, with this difference, that the wound was closed with seven interrupted sutures instead of four, about two lines from each other. She bore the operation well, and lived without any untoward symptoms until the seventeenth day, when she was killed. The external wound was beautifully healed, and a considerable quantity of adeps was found beneath the skin of the abdomen. There was no adhesion of the bowel or omentum to the parietal portion of the peritoneum, and the internal wound, situated within a few inches of the ileo-cæcal valve, was in great measure healed; three of the sutures, however, still retained their hold. No evidence of inflammation was discoverable at the seat of the injury, and the tube had undergone no contraction.

EXPERIMENT III.—Transverse wound embracing three-fifths of the cylinder of the small bowel—three interrupted sutures—the ends of the ligature cut off near the knots—recovery—the animal killed near the end of the third month.

May 23, I cut the small intestine three-fifths across, eighteen inches from the ileo-cæcal valve, making a wound about fourteen lines in extent, the edges of which were brought together by three interrupted sutures, at equal intervals from each other, and the ends cut off as in the preceding experiment. The animal, which was healthy and of moderate size, had been fasting for twenty-four hours. No blood was lost during the operation, from the effects of which he speedily recovered. On the 16th of August, being in good condition, he was killed, and the body carefully inspected. The outer wound was perfectly cicatrized, as was also that in the bowel. The latter, however, was somewhat rough on its external surface, from the attachment of a small narrow process of the epiploon, which was partially ulcerated, and would doubtless in a few days more have lost its entire connexion. Internally the reparation was beautifully perfect. No adhesion existed between the bowel and the wall of the abdomen, or between any of the intestinal convolutions.

EXPERIMENT IV.—Transverse wound occupying four-fifths of the circumference of the tube—four interrupted sutures—the dog killed on the ninth day.

In this experiment, which was performed on a middle-sized dog after he had fasted for eighteen hours, the small bowel was cut four-fifths across, three feet and a half from the ileo-cæcal valve, and the wound united by four interrupted sutures, equidistant from each other. One end of each ligature was brought out at the external opening, and the other cut off close to the knot. The animal rapidly recovered from the shock of the operation, and lived until the ninth day, when he was killed. The protruding ligatures were detached, and the edges of the external opening firmly united, with a small process of omentum intervening between

them. The internal wound was partially cicatrized, and exhibited well marked traces of the situation of the sutures. The parts immediately around were rough and knobby, from the presence of lymph and adherent omentum; but there was no abnormal vascularity or evidence whatever of inflammatory action. The bowel contained fæcal matter, and was as large as natural. The animal had not lost any flesh.

EXPERIMENT V.—Transverse section embracing five-sixths of the intestinal cylinder—four interrupted sutures with both ends cut off—the animal killed in three weeks.

The subject of this experiment was a small pup not more than five or six months old. The small bowel was cut five-sixths across, and the everted mucous membrane pared away on a level with the peritoneum. I then passed the needle through all the coats of the intestine, hoping thereby to approximate more completely the serous surfaces. In this, however, I found myself mistaken; for no sooner did the instrument enter the muscular lamella than violent contractions ensued, producing fully as much eversion as before. Four interrupted sutures, with the ends cut off close to the peritoneal surface, were employed, and the whole returned within the abdomen. The dog became sick a short time after the operation, and had repeated vomiting; but he gradually recovered, and escaped, at the expiration of the third week, in good health.

EXPERIMENT VI.—Semi-division of the bowel—two interrupted sutures with one end protruding—the animal killed on the thirty-sixth day.

On the 10th of August, I opened the abdomen of a female tarrier, and cut the small bowel half across, three feet from the ileo-cæcal valve, sewing up the wound, which was about three-quarters of an inch in length, with two interrupted sutures, one end of which was left hanging out at the external opening. The animal experienced apparently very little inconvenience from the operation, and

was killed in good health on the 16th of September, or the thirty-sixth day after. The external wound had healed without the intervention of the omentum, which, however, adhered to several intestinal folds. The internal wound was beautifully cicatrized; all trace of suture had disappeared, and there was no mark whatever of recent inflammation, either in the serous or mucous tissues. The tube was of the normal size.

b.—*Longitudinal Wounds.*

EXPERIMENT I.—Longitudinal wound two inches long—four interrupted sutures—the ends of the ligatures cut off near the peritoneal surface—the animal killed after the third month.

An incision, two inches in length, being made along the convex surface of the ileum, a little more than a foot from the ileo-cæcal valve, I approximated the edges with four interrupted sutures, equidistant from each other, and cut off the ends close to the peritoneal surface. The dog, which was large and old, lost a good deal of blood during the operation, and the wound was still bleeding, though not freely, when I returned the bowel into the abdomen. He rapidly recovered from the effects of the injury, and continued in excellent health until he was killed on the 22d of September, upwards of three months after the experiment. The epiploon adhered to the surface of the bowel, and a small process projected into the outer wound. The internal wound was perfectly cicatrized, so much so, that some difficulty was experienced in detecting its situation: two coils of the intestine were united together at the seat of the injury. The dog was fat, and all the viscera were free from disease.

EXPERIMENT II.—Longitudinal wound one inch long—four interrupted sutures—the ends of the ligatures brought out at the abdominal opening—the animal killed on the twelfth day.

A large healthy dog, having fasted for twenty-four hours, was subjected to the same experiment as the preceding, with

this difference, that the wound was only one inch long, and that the ends of the ligatures were brought out at the external opening. Nothing unusual occurred after the operation, which he bore with comparatively little resistance. On the twelfth day, being considered out of danger, he was killed. The abdominal wound was cicatrized throughout its entire extent with the intervention of a plug of omentum, a small mass of which also adhered to the injured bowel. The latter was slightly agglutinated to several of the neighboring coils, and on laying it open the villous portion of the breach was found to be well repaired, the edges being rounded off, and connected by plastic lymph. The tube at the seat of the lesion contained alvine matter, and was of the natural diameter. No inflammation was observable either in the serous or mucous coat. It should have been stated that all the ligatures were detached on the sixth day.

EXPERIMENT III.—Longitudinal wound one inch in length—four interrupted sutures—the ends of the ligatures cut off close to the knots—the animal killed on the twenty-second day.

This experiment was merely a repetition of the last. Instead, however, of bringing the ends of the ligatures out at the abdominal wound, they were cut off close to the peritoneal surface. The dog was small but full-grown, and had fasted for twenty-four hours. He bore the operation remarkably well, appeared very sprightly soon after it was over, and drank a considerable quantity of water. No untoward symptom arose, and he continued perfectly well until the twenty-second day, when he was killed. The appearances on dissection were found to be essentially the same as in the cases already mentioned. A piece of omentum was attached to the entire surface of the intestinal wound, the reparation of which was unusually perfect. All trace of suture had disappeared, and the continuity of the villous surface was, in a great degree, re-established. There was some adhesion between the neighboring folds of the small bowel, and a process

of the epiploon was prolonged, as usual, into the abdominal wound.

EXPERIMENT IV.—Longitudinal wound five-eighths of an inch long—two sutures with the ends brought out at the external wound—recovery.

The subject of this experiment was a small dog four or five years old. The wound, five-eighths of an inch in length, was made, as usual, along the convex surface of the bowel, and closed with two interrupted sutures. The ends of the ligature were twisted together, and left hanging out at the external opening. The animal bore the operation well, and was apparently in perfect health a few hours before his escape, which happened at the end of the ninth day.

EXPERIMENT V.—Longitudinal wound half an inch long—one suture with the ends cut off at the knot—the animal killed at the expiration of the seventh day.

From the abdomen of a large slut I drew a fold of the ileum within fifteen inches of the ileo-cæcal valve, and making a longitudinal incision along its convex surface, six lines in length, I closed it with a single suture, the ends of which were cut off at the knot. No untoward symptom arising, and being considered past all danger from the operation, she was killed at the expiration of the seventh day. The outer opening was pretty well healed, with a portion of epiploon adhering around its inner margins, as well as to the surface of the intestinal wound, and to several neighboring knuckles. The suture had disappeared, reparation was going on beautifully between the villous edges, and the bowel, containing fæcal matter, had experienced no change in its caliber. The quantity of lymph poured out by the peritoneal surface was very small, as was proved by the trifling nature of the adhesions. The dog was fat, and had lost no flesh from the operation.

EXPERIMENT VI.—Longitudinal wound half an inch in length—one suture with the ends cut off close to the knot—death on the eleventh day from causes apparently unconnected with the operation.

This experiment was merely a repetition of the last. Although only one suture was employed, it seemed to have the effect of closing the opening completely. The dog, which was very small and not more than three or four months old, bore the operation exceedingly well, and had no untoward symptoms prior to his escape, which took place three days thereafter. He remained at large until the eleventh day, when he was met in the immediate vicinity of the dog-house in a paroxysm of convulsions, in which he was knocked on the head and killed. On dissection I noticed the following appearances. The outer opening was perfectly healed, except at one or two points, with a small slip of omentum prolonged into it. No peritoneal inflammation was observable any where; the bowels did not adhere to each other or to the abdominal walls; the ligature was detached; and the continuity of the affected portion of the tube was re-established by a process of the epiploon, which was firmly attached around the wound for some distance. The edges of the latter were one-third of an inch apart at the centre; the mucous membrane was not at all red or inflamed; and the small intestine was empty and blanched. What caused his convulsions I could not determine.

c.—*Oblique Wounds.*

Only two experiments were performed with a view of illustrating the treatment of oblique wounds by the interrupted suture, and of these the following synopsis must suffice.

EXPERIMENT I.—Wound six lines long—two interrupted sutures through the cellulo-fibrous lamella—the animal killed at the end of the third week.

The dog, old and of large size, had fasted for nearly twenty-four hours. The wound was made along the convex surface

of the small bowel, opposite the attachment of the mesentery, and about twenty inches from the ileo-cæcal valve: it was six lines in length, and closed with two interrupted sutures carried through the cellulo-fibrous lamella. The ends were cut off near the peritoneal surface. Nothing worthy of notice occurred after the operation, and the dog, being in good health, was killed at the expiration of three weeks. On opening him I found that both sutures had disappeared, leaving merely a slight circular depression which served to indicate their former situation. The mucous portion of the wound presented a linear or fissured aspect, and might be said to be in great measure cicatrized. The serous surface had contracted firm adhesions to the mesentery, and the tube retained its normal dimensions. The omentum adhered slightly to the small intestines, and a process of it was prolonged into the outer wound, which was completely consolidated.

EXPERIMENT II.—Wound one inch and a half in length—five interrupted sutures—the ends of the ligatures cut off close to the knots—the animal killed upwards of a month after the experiment.

The animal was small, but full-grown, and the wound, eighteen lines in length, was united by five interrupted sutures, equidistant from each other. The ends were cut off close to the knots. The wound, as in the foregoing experiment, occupied the inferior extremity of the ileum. The dog soon recovered from the shock of the operation, and was killed one month and three days after. The sutures had all disappeared, and the wound was neatly cicatrized throughout, excepting at two or three small points, where the edges were somewhat elevated and puckered. It had diminished nearly six lines in length. The tube was slightly contracted at the seat of the injury, but not sufficiently to interfere with the transmission of the alvine matter. Externally the bowel adhered firmly to two adjacent convolutions, together with a fold of the epiploon. The abdominal wound was entirely healed.

Of the foregoing experiments, two were fatal, death being

produced in one by peritoneal inflammation, in the other without any obvious cause. The suture was carried through all the tunics in thirteen, and in one through the cellulofibrous lamella. In ten, both ends of the threads were cut off close to the peritoneal surface; in two, they were brought out at the external opening; and in the remainder, one extremity was cut off, and the other secured to the surface of the abdomen.

The most important circumstances to be observed in making this suture in wounds of the bowels are, to carry the needle through the cellulofibrous lamella, and to place the stitches sufficiently near each other to prevent the escape of fæcal and other matters. It will be perceived that in some of the above experiments the interval between the stitches was as much as four or five lines, and yet no effusion occurred. Such a practice, however well it may answer in the inferior animals, is certainly inapplicable to the human subject, whose safety should never be jeopardized by inattention to the dictates of sound experience.

It will be seen that in these experiments, as in those with the continued suture, the caliber of the intestinal tube was not seriously diminished in a single instance. Indeed, in nearly all the cases in which the parts were examined, it was quite as large at the seat of the injury as in the natural state.

I subjoin the following cases in which the interrupted suture was employed in the human subject. Taken in connexion with the experiments just detailed, they exhibit an array of success highly favorable to this method of treatment.

CASE I.—Extensive wound of the abdomen, with complete division of the ileum, and penetration of the thoracic cavity—four interrupted sutures—recovery in a month.*

Henry Cooper, seven years of age, had his belly ripped open by a boar on the 23d of August, 1815, soon after eating a small piece of bread and bacon with two apricots.

* Edinburgh Medical and Surgical Journal, vol. xii, p. 27.

Nearly the whole of the abdominal viscera, the stomach, a large portion of the intestinal canal, the mesentery, and omentum were protruded through an immense wound on the left side of the median line. The ileum was completely severed, the omentum was lacerated through its entire extent, and a rent an inch long existed in the mesentery. On the left side of the chest was a lacerated wound five inches long, communicating with the cavity of the chest, and complicated with fracture of the fifth and sixth ribs. The wound in the wall of the abdomen commenced about an inch below the antero-superior spinous process of the iliac bone, from which it reached, in an oblique direction, to the right side of the ensiform cartilage of the sternum. Mr. Calton, surgeon at Collingham, brought the edges of the intestinal wound together by four interrupted sutures, made with a small curved needle and a double silk thread. A firm hold was taken by carrying the instrument through all the tunics of the gut, and each ligature was cut off close to its knot. The omentum was returned without any other attempt to approximate its divided edges than laying them together. The wound of the abdomen was secured by sutures and adhesive straps, supported by a broad bandage.

For the first forty-eight hours after the occurrence of the accident there was great restlessness, high fever, tenderness and tumefaction of the abdomen, and irritability of the stomach. On the twenty-fifth the boy vomited up some undigested ham, two apricot-stones, and several lumbricoid worms, with great mitigation of his symptoms. The following day he had a copious liquid evacuation from his bowels, from the administration of a dose of castor-oil, aided by an enema of sulphate of magnesia. The external sutures came away on the twenty-ninth and thirtieth of August, and in a month the wounds were perfectly cicatrized. The little patient was of course much emaciated, and the wall of the abdomen, at the original seat of the injury, was so thin as to allow the peristaltic action of the intestine to be plainly seen through it.

CASE II.—Four wounds of the small bowel with injury of the omentum—treatment by the interrupted and continued suture—recovery in a fortnight.*

An athletic young man, twenty years of age, in carelessly handling a scythe, on the 26th of August, 1836, with the point turned towards the body, accidentally pierced his belly a little above the left of the umbilicus, inflicting a longitudinal wound five inches in length externally, but not quite so extensive within. The omentum was perforated and the jejunum opened in four places. One of the wounds in the latter reached nearly entirely across the gut, the second rather more than one-half, the direction of both being transverse: of the other two, one was a mere puncture, yet sufficient to allow the escape of fœcal matter, while the other, which was a longitudinal slit, was two inches in length. A large mass of the small intestines, a portion of the colon, and the omentum protruded through the outer wound, and were found, nearly four hours after the accident, covered with dried blood and fæces, the latter of which had issued in considerable quantities. The patient was in great suffering, his symptoms resembling those of strangulation of the bowels, which, indeed, was the case. After thoroughly cleansing the protruded viscera with tepid milk and water, Dr. Aquila Toland, of Madison county, Ohio, who attended the patient, brought the lips of three of the wounds together by the interrupted suture, made with broad linen threads. The large transverse cut was treated with the glover's suture, that is to say, the two small needles which he used for that purpose were passed alternately from one side to the other between the mucous and muscular tunics, the former being pushed back and excluded from the ligature. The parts were then returned into the abdomen, having previously somewhat enlarged the outer

* Western Journal of the Medical and Physical Sciences, vol. 10, p. 481.

wound, the edges of which were next brought into apposition and retained by the quilled suture. Two days after the operation a small process of omentum was discovered in the lower angle of the external opening, upon pushing back which, a copious discharge of bloody pus occurred, followed by great relief of the hypogastric distention. On the thirty-first of August the patient had, for the first time since the accident, a free evacuation from the bowels; on the fourth of September, all unfavorable symptoms had disappeared; and in a fortnight the outer wound was nearly cicatrized.

CASE III.—Perforation of the small bowel by the horn of an ox—interrupted suture—dilatation of the abdominal wound—complete recovery.*

William Kemble, twenty-one years of age, of spare habits, a butcher by occupation, was gored in attempting to slaughter an ox, December 11th, 1832, the horn penetrating the abdomen just above Poupart's ligament. Through this opening about six inches of small intestine protruded, which was at the same time strangulated. On examining the gut it was found to have been completely perforated by the animal's horn, which had entered it on one side and come out at the other, producing consequently two apertures, capable each of admitting a finger. No fæces had escaped, nor had there apparently been much hemorrhage. Mr. J. D. Davids, a surgeon of Cowes, being called to the case, immediately brought the lips of the larger wound together with two sutures, and those of the smaller with one, the ends of the ligatures being cut off close to the knots. He then attempted to return the bowel, but found this impracticable without dilating the external wound, which was accordingly done with a probe-pointed bistoury. The outer opening was closed with sutures, supported by straps of adhesive plaster. For the first few days there was considerable restlessness, with vomiting and tenderness of the abdomen. On the fifteenth

*Medico-Chir. Review, vol. xx, p. 182.

some oil was given by the mouth, which acted very well on the bowels, and from this period he went on progressively improving. One of the sutures only made its way out through the wall of the abdomen, the two others fell into the intestinal canal, and were passed with the fæces. Complete recovery ensued.

CASE IV.—Oblique wound of the small intestine, three-fourths of an inch long—four interrupted sutures with the ends cut off close to the peritoneal surface—recovery in five weeks.*

M. Sullivan, aged twenty-six years, a native of Ireland, was admitted into the New-York Hospital, under the care of Dr. Buck, on the 17th of August, 1840, with a stab in the abdomen, received an hour before in a quarrel. The external wound, which was situated on the left of the median line, midway between the pubes and umbilicus, was an inch long, and gave vent to several knuckles of small intestine, in one of which was an oblique cut three-fourths of an inch in extent. The protruded parts were of the natural warmth and of a deep red color; the patient was faint and restless; he had frequent vomiting, with insatiable thirst; and the pulse was weak and small. Four sutures of fine silk thread were introduced into the inner wound; they included all the tunics of the bowel, and the ends were cut off close to the knots. Reduction was then attempted, but did not succeed until the outer cut was dilated to the extent of half an inch at its upper edge. The outer wound was then united with two sutures and adhesive strips, the whole being supported by a broad bandage. During the first day ten ounces of blood were taken from the arm, and four dozens of leeches applied to the abdomen. On the 18th the patient was comfortable; there was pain, however, on pressure at the seat of injury; and towards evening, the pulse having increased in force and tension, the venesection was repeated to

* New-York Journal of Medicine and Surgery, No. 8, April, 1841.

twenty ounces. On the 19th he made several fruitless attempts at stool, and the belly became tympanitic and somewhat swollen; for these symptoms a large blister was applied, and an emollient enema administered. On the 23d of August he was leeches on the right iliac region, and from this period his convalescence was completely established; the bowels moving spontaneously or by the aid of injections, and the tenderness disappearing from the abdomen. The external wound healed kindly, partly by the first intention; and in about five weeks he began to sit up. His recovery, however, was retarded by an attack of inflammation of the chest, and effusion into the cavity of the peritoneum. These gradually yielded to appropriate treatment, and he left the hospital on the 28th of October.

CASE V.—Two incised wounds of the small intestines, each more than half an inch long—interrupted suture—recovery in a fortnight.*

Ezekiel, an athletic negro, aged thirty years, in a night broil, was wounded in the arm and abdomen with a knife, the latter injury involving one of the small bowels, which was cut in two places to the extent of more than half an inch. Several branches of the mesenteric artery were divided and bled freely. The bowel protruded through the wound. Having washed off the coagulated blood, the divided vessels were included in fine silk ligatures; "after which," says Dr. Yandell, "the openings in the gut were each closed with the same species of thread, but whether more than one stitch was used, I am not able, at this distance of time, to say." In two weeks the man had so far recovered that it was no longer necessary to visit him.

* I am indebted for the above case to my friend and colleague, Professor Yandell. As it occurred more than ten years ago, and no notes were taken of it at the time, it is not so circumstantially reported as could be desired.

The following cases, although they had an unfavorable termination, throw additional light upon this important subject. They occurred in the practice of Sir Astley Cooper, and are recorded in his great work on the Anatomy and Surgical Treatment of Abdominal Hernia, edited by C. Ashton Key, Esq.

CASE I.—Strangulated crural hernia in a woman fifty years of age—mortification of the ileum, and excision of the affected part—three interrupted sutures with the ends protruding through the outer orifice—artificial anus—death on the fifth day after the operation.

A woman, fifty years of age, had been laboring under strangulated crural hernia from the first until the eighth of November, when Sir Astley Cooper was requested to visit her for the purpose of performing an operation for her relief. Her features at this time were anxious and collapsed; the pulse was one hundred and thirty a minute; there was great thirst; the abdomen was distended and tender on pressure; the bowels had been obstinately constipated for more than a week; there was frequent vomiting of a yellowish fluid, of fæculent odor; and the tumor was red, hard, and exquisitely painful to the touch. Having laid open the hernial sac, a quantity of liquid fæces immediately escaped from it, which was found to have proceeded from a large circular opening of the ileum, with dark, thickened, and everted edges. After the stricture was fully divided, he cut away the mortified piece of bowel, which was about two inches and a half long, and joined the two fresh ends by three sutures, leaving a small aperture for the evacuation of fæces, and confining the ligature which passed through the back part of the tube next the mesentery to the mouth of the hernial sac. The external wound was closed in the usual manner, except at one point for the passage of alvine matter. She died on the morning of the 12th of November, every thing that she swallowed having in the mean time been speedily discharged at the groin. The integuments over the artificial anus were of a livid color, but not mortified, and she had no passage

since the attack. On dissection the protruded part of the tube was found to be firmly glued to the inner side of the sac, and the small bowel above this point highly inflamed throughout. The stomach was pale and contracted; the large intestine was free from disease; and there was no effusion of fluid into the peritoneal cavity, nor any adhesion of the abdominal viscera.

CASE II.—Strangulated crural hernia—patient sixty-eight years old—mortification of the bowel—excision of the affected part—three interrupted sutures with the ends protruding through the outer orifice—artificial anus—death in ten weeks.

This case was likewise one of crural hernia; the patient was a female, sixty-eight years of age, and the strangulation had existed for five days. When Sir Astley Cooper saw her, on the 31st of July, she had repeatedly vomited, and there was slight hiccough, with a small and frequent pulse. The tumor was much inflamed, and pitted under pressure. After exposing the bowel, he discovered that it was mortified to the extent of about three-quarters of an inch, and that there were two holes in it, one of which was large enough to admit the blunt end of a probe. Both apertures were of a circular form, and readily permitted the escape of fæcal matter when pressure was applied to the adjoining portions of the tube. With a pair of scissors he cut away the sphacelated piece, and then united the parts by three sutures. The divided edges bled freely, but the hemorrhage was checked when the ligatures were drawn together. The intestine was then pushed as near as possible to the mouth of the hernial sac, and the threads left hanging from the wound. The protruded omentum was cut off, and the external opening every where closed, except at the centre, to allow of the escape of faecal matter, should it be disposed so to do.

On the second day after the operation a large quantity of liquid fæces passed from the wound, and in a short time afterwards the artificial anus appeared to be fully established, the opening into the bowel being large enough to admit the

finger. From this time until the twenty-third of September the case presented nothing of any particular interest. At this period the wound was very much contracted, the hole in the bowel was greatly reduced in size, and all discharge of fæces had ceased, owing, as was supposed, to her having eaten some rabbit and roasted apple. She vomited, and the belly became distended. After remaining in this state for forty-eight hours, a large alvine evacuation took place from the wound; but her strength gradually declined, and she expired on the 9th of October. On opening the body, the abdomen was found free from inflammation. The lower part of the ileum formed the artificial anus. The large bowel was much contracted, and contained only a little mucus. The orifices of the intestine were both very small, the lower much more so than the upper.

Who can doubt that the last case would have recovered, if it had been properly managed? Had a few more points of suture been used, the formation of an artificial anus would have been prevented, and nature effected speedy reparation. As it was, the continuity of the tube was interrupted, and when the external opening became greatly reduced in size, as it did a short time before death, obstruction with its whole train of evils was the necessary and inevitable consequence. Even in the first case it is not improbable that recovery might have taken place, if the divided parts had been approximated in such a manner as to prevent the establishment of an artificial anus. During the four days which the patient survived, every thing she drank passed by the preternatural opening, the bowels below remaining in the meantime obstinately constipated. It is true the inflammation might have extended too far before the operation was performed, but this is a mere conjecture, and does not invalidate the belief that, had the wound been carefully sewed up, and the continuity of the canal re-established, restoration might have occurred.

3.—*Method of Ramdohr.*

This method derives its name from Ramdohr, an eminent German surgeon, who flourished at the commencement of the last century. It consists in joining together the two ends of the divided bowel by introducing the upper within the lower, and fixing it there by means of a suture, the extremities of which are brought out at the opening in the abdomen. Ramdohr, I believe, was the only surgeon who, until recently, performed this operation on the human subject; his patient, a female, was affected with strangulated crural hernia, and, although he removed two feet of mortified intestine, perfect recovery soon ensued. About a year subsequently to the operation she died of an attack of pleuritis, when the bowel was carefully inspected, and the two ends were found to be beautifully united to each other and to the wall of the abdomen. The preparation was sent to Professor Heister, of the University of Helmstadt, who preserved it in alcohol,* and published an account of it in his *Institutes of Surgery*. To facilitate the invagination, Ramdohr recommends the division of a small portion of the mesentery along the concave surface of the tube, and the insertion of a piece of candle.

“Et excisa magna intestinorum parte corrupta, binas partes extremas, easdemque sanas, superiori inferiorem insinuata, leniter per injectum filum conjunxit. In abdomen reposuit, flique circumducti ope ad vulnus abdominis attraxit; atque ita non modo efficit ut cum vulnere confervesceret, et ad glutinationem quod mirum videri poterat, intestinum divisum perveniret, sed feminam quaque velut ex ipsis mortis faucibus retraheret, facibus postea non per vulnus, sed per anum egredientibus. Mulier illa posta sana vixit; at post annum ex pluritudine abiit, atque in inciso cadavere intestina divisa inter se rursus coalita deprehensa sunt: quæ ipsæ mihi una cum parte abdominis cum qua coaluerunt, dono dedit; ea que adhuc in spiritus vini asservo, ut dubitantibus aut discentibus ea semper attendere possim.”—Heister, *Institutiones Chirurgicæ*, T. i., p. 768, in 4to.

The objections to this procedure are, first, the impossibility of distinguishing the upper from the lower end; secondly, the difficulty of effecting the invagination; thirdly, the tardy and imperfect adhesion from a serous surface being placed in contact with a mucous; and fourthly, the danger of hemorrhage from the division of the mesenteric arteries. I shall examine these objections in detail.

The difficulty of distinguishing the two ends from each other is always great, if not absolutely impossible. One of the most important signs enumerated by authors is the disproportionate contraction of the inferior extremity. This occurrence, however, although it may occasionally happen, is, nevertheless, exceedingly rare, and cannot therefore be depended upon. I have seldom noticed it in my experiments, and the same remark has been made by others. The contraction is sometimes more conspicuous in the upper than in the lower end, sometimes it is entirely wanting, and sometimes it is nearly equal in both divisions. Professor Bérard, of Paris, who was called to a female who had cut out two feet of her small bowels, relying upon the certainty of this sign, was unwittingly led into the error of inserting the inferior into the superior orifice, as was shown by the autopsy, the patient dying in thirty-six hours.*

Louis proposed the administration of a small quantity of olive-oil, to promote the peristaltic action of the alimentary canal. The alvine matter above the seat of the injury would thus be evacuated through the superior orifice, and so lead to its detection. This is, however, to say the least, a tardy and uncertain procedure, and one to which few practitioners of the present day would be likely to trust. Where the stomach is oppressed, as it almost always is in wounds of the bowels, with nausea and vomiting, no medicine, however mild, would be likely to be retained sufficiently long to pass the pyloric orifice. Granting, however, that it might reach the bowel, a number of hours would necessarily elapse before

* London Lancet for 1835-'6, p. 45.

it could produce the desired effect. In the meantime the patient would be subjected to the pain and hazard resulting from the exposed condition of the protruded viscus, which should always be returned as speedily as possible; for the longer this is delayed the greater will be the risk of severe peritonitis and the probability that the patient will die from the shock of his wounds. But I need not dwell upon this proposal, as it is altogether unlikely that it will be carried out by any practitioner of the present day.

A recent writer, Mons. Jobert, observes* that in a sphacelated hernia the escape of the intestinal contents would show which was the upper end; while, in the case of division by a wound, the method suggested by Louis would be the best, especially if the oil were mixed with some coloring substance, as syrup of violets or orchanet. "In order to distinguish," says Professor Cooper, "the upper end of the intestine from the lower, the proposal is sometimes made to give the patient a little milk, and to observe whether the fluid, after a time, issues from the mouth of the protruded gut."†

Some diversity of sentiment still exists in respect to the absolute necessity of distinguishing the two ends from each other. Jobert thinks it of paramount importance, on the ground that if the inferior be inserted into the superior it will lead to inversion and obliteration of the tube, followed by death from inanition; in proof of which he refers to an experiment by himself on a dog in which this result actually happened. On the other hand, there is now on record at least one example in which the reverse occurred in the human subject. Such, at all events is the probability, for as the patient recovered no decisive examination could of course be made. I allude to the case mentioned by Dr. Pitcher, to which I shall hereafter refer in connexion with Ramdohr's process, and in which the lower portion of the small bowel was inserted into the upper. "I did this," observes Dr.

* Op. cit. T. i, p. 85.

† Dict. Surgery, p. 503. New-York edition.

Pitcher," because the lower end had been already, by the butcher's knife, freed from its connexion with the mesentery, in which I found the chief impediment to this mode of junction. The peristaltic contractions occasioned by handling the bowels embarrassed the operation very considerably, but that difficulty was overcome by the manner of passing the ligatures already described."*

In respect to the difficulty of effecting the invagination there is hardly a practical writer that does not fully concur in it. It has been already stated, in a previous section, that when a bowel is completely divided, there is not only retraction of its extremities but also a certain degree of contraction, by which the caliber is sometimes diminished one-half or even two-thirds, or, rather, I might say, almost entirely obliterated. Now any attempt under these circumstances to insert the superior end into the inferior, provided it was always possible, which, as we have just seen, it is not, to distinguish them from each other, would inevitably prove abortive, unless the parts were most forcibly dilated, and even then it would be almost impracticable. Of the truth of this abundant evidence has been furnished me by my own researches, multiplied and repeated as they have been in a great variety of ways and in numerous instances. If any further proof, however, is needed it is only necessary to refer to the experiments of Mœbius, a cotemporary of Ramdohr, and to the more recent ones of Dr. Smith and Mr. Travers, before adverted to, in which they uniformly failed to accomplish this object. "Having divided," says Smith, "the intestine of a dog transversely, I attempted to treat it in the manner spoken of by Mr. Ramdohr, namely, by introducing the upper extremity within the lower; after having procured a piece of candle, as directed by him, it was inserted into that portion of the intestine which was supposed to be the uppermost. I then endeavored to introduce the superior within the inferior, but the extremities of each became so everted that it was utterly impossible to succeed; it was therefore given up, and

* American Journal Med. Sciences. vol. x, p. 47.

treated in the way recommended by Mr. John Bell.* To the same import precisely is the testimony of Sir Astley Cooper. "Some years ago," he observes,† "I divided the intestine of a dog, with a view of trying to introduce the one intestine within the other; but I had no sooner made the division than the intestines became everted, and so bulbous at each extremity that I found it impossible to pass one within the other; and that this also takes place in the human subject is proved by a preparation of wounded intestine in the Museum at St. Thomas' Hospital, taken from a man who had been kicked by a horse. The jejunum was ruptured, and it appears everted." Such, indeed, must be the experience of every practitioner who has had an opportunity of witnessing a lesion of this kind, whether in the human subject, or in the lower animals.

To overcome this contraction, Professor Velpeau thinks the best plan would be to seize simultaneously the two principal diameters of the inferior end by their four extremities with an equal number of forceps or hooks. Swelling or distention of the upper end may be prevented by an assistant holding and compressing it, while the operator endeavors to introduce it into its destined situation.‡ This plan, however, is by no means free from objection, since it can only succeed at the expense of much pain to the patient, and the risk of creating unnecessary inflammation. I have tried it in several instances, and this is precisely the conclusion at which I have arrived.

The third objection to this proposal is the apposition of a serous with a mucous surface. This constitutes no little impediment to the reparative process, which can be accomplished only after a long time, and then probably in a very imperfect manner. Indeed, Mr. Lawrence and others are inclined to suppose that direct union cannot be effected at all under these circumstances, asserting that the success depends

* Inaugural Essay, Caldwell's Collection, p. 296.

† Treatise on Hernia, p. 54. London, 1827.

‡ *Médecine Opératoire*, T. iv, p. 134.

altogether upon the extent and firmness of the collateral adhesions; an opinion which, there is reason to believe, is in the main well founded.

Lastly, the upper part which is to be inserted into the lower, must be separated from the mesentery, a procedure which sometimes exposes the patient to considerable risk from hemorrhage. Of this fact my own experiments have afforded me a number of striking and convincing proofs. Baron Boyer, of Paris, in attempting to put this method into execution, tied not less than seven or eight arteries, and yet his patient died from effusion of blood into the abdomen.

Velpeau states that he saw this method tried at the St. Louis Hospital in Paris, by Professor Richerand, upon a patient who died the following day.* Baron Boyer executed it with no better success.† His patient, an athletic brasier, about forty-five years of age, had been affected with strangulated inguinal hernia for three days, and on exposing the bowel he found that it was mortified. He accordingly made an incision to the extent of four inches into the sphacelated part, and thus allowed the escape of its contents, to the great relief of the individual. The operation over, he administered mild opening medicines, both to evacuate the alimentary canal, and to enable him to distinguish the upper extremity of the gut, which, however, was already sufficiently obvious from its dilated condition. The next day he cut away the mortified portion, and united the two ends according to Ramdohr's method, introducing the superior, supported by a cylinder of card, into the inferior. The operation, however, was not only tedious but extremely painful, and when completed, he found it impossible to return the gut, distended as it was by the foreign body, without a considerable enlargement of the ring. The patient grew decidedly worse during this second operation; the symptoms of strangulation, which had been relieved by the free discharge of fæcal matter through the

* Op. cit. T. iv, p. 134.

† *Traité des Maladies Chirurgicales*, T. viii, p. 134.—Lawrence on Ruptures, p. 359.

mortified part, were soon renewed, and destroyed the patient in sixteen hours. The dissection revealed inflammation of the intestines and a slight effusion of blood into the peritoneal cavity.

Flajani, of Rome,* also tried the artifice on several occasions, but death was invariably the consequence. He experienced great difficulty in his attempts to invaginate the divided extremities of the bowel, and speaks of the practice in terms of decided condemnation.

Notwithstanding these difficulties and disasters, it would seem, from the testimony of a recent writer, Professor Velpeau, that Laviellé, Chemery-Havé, and Schmidt have each reported a successful example in support of the practice. Another, which occurred in our own country, was published a few years ago, by Dr. Zina Pitcher of the United States army, and, from the manner in which it was treated, reflects much credit upon that gentleman. The following is an abstract of it.†

Nicholas Miller, a citizen of the Cherokee nation, was stabbed on the 22d of June, 1831, with a butcher's knife, which, entering the abdomen at the left internal ring, passed upwards and inwards towards the median line, making a wound three inches in length in the skin, and another still more extensive in the peritoneal sac, followed immediately by a protrusion of several feet of intestines. The knife had divided the ileum diagonally, and separated two inches of the lower portion of the mesentery. The fold of intestine in contact with this was cut on its convex side two-thirds across; two other convolutions were transpierced, and the descending colon was partially opened in the direction of its circular fibres. Three branches of the mesenteric artery bled pretty profusely, and were included in separate ligatures, the ends of which were cut off close to the knots. The extremities of the ileum were brought together by passing a needle, armed

* Collezione d'Osservazioni, &c., di Chirurgia, T. iii, p. 60. Roma, 1802.

† American Journal of the Medical Sciences, vol. x, p. 42.

with a thread, through the upper portion from without inwards, thence into the lower part and out again, including half an inch of intestine in the stitch, after which it was returned through the upper end from within outwards. Three sutures of this kind made the intus-susception complete. The extremities of the ligatures were cut off near the peritoneal surface. The other openings of the small bowel were closed with the continued suture, the ends of which were left long, and so tied as to hang within the tube. The wound in the colon was united with a single stitch. The prolapsed intestines were next sponged with warm milk and water and returned into the abdomen; a few pieces of the omentum which had been injured by the knife were excised, and the edges of the outer wound approximated by half-a-dozen turns of the continued suture. The external ligatures were detached on the fifth of July, and by the eleventh of the month the wound in the abdomen was completely healed.

Laviellé's case occurred at Mainbaste, in the department of Landes, in France, and is recorded in the forty-third volume of the "*Journal Général de Médecine*." The following notice of it is taken from Jobert's treatise on the surgical diseases of the alimentary canal.* The patient was affected with inguinal hernia of the left side, which at length became strangulated. The tumor was of considerable volume; gangrene supervened, eventuating in the sloughing of the common integuments, and the effusion of fæcal matter. A longitudinal incision being made down upon the parts, a coil of intestine, a foot long and completely sphacelated, was removed with the scissors, when the extremities of the tube were fastened to the outer opening with a thread carried through a fold of the mesentery. At the expiration of twenty-four hours, Laviellé invaginated them by inserting the superior within the inferior, and keeping them in contact with the ligature previously attached to the mesentery, the ends of which, after the replacement of the gut, were brought out at the wound

* T. i, p. 85.

in the abdomen. The next day the man walked to the guard-house, and continued so to do regularly during the treatment. The cure was completed in sixty days.

4.—*Method of Le Dran.*

Le Dran was a warm advocate of what is denominated the *looped suture*, of which he was the inventor.* Whether he ever employed it in the human subject for purposes of this kind, I am unable to say, as I have not before me a copy of his works. It is not improbable, however, that he did. To perform this suture, as many needles should be used as it is intended there should be stitches; they should be round, straight, and slender, and furnished each with an unwaxed thread a foot long. The lips of the wound being held by the surgeon and his assistant, as many ligatures are passed through them as may be considered requisite, with the precaution to let the intervals between each two of them not exceed a quarter of an inch. When the sutures are all introduced and the needles removed, all the threads of one side of the cut are tied together at their ends, and then those of the opposite side, after which the whole are united and twisted into a sort of cord. The stitches by this procedure are approximated to each other, and the divided extremities of the intestine thrown into plaits, by which the edges of the solution of continuity are, it is said, prevented from gaping. The bowel being replaced, the threads are secured to the bandage



* *Traité des Operations Chirurgicales.* Paris, 1742.

which is put over the dressing, and the outer wound is closed in the ordinary manner. When the injury is sufficiently repaired, which rarely happens under five or six days, the ligatures are untwisted, and all the ends on one side cut off on a level with the skin, after which the others are to be slowly and cautiously withdrawn.

The advantages which Le Dran claims for this suture are the two following; first, that the twisting of the threads, as stated above, produces a slight puckering of the surface of the injured bowel, by which the re-union of the edges of the wound is more effectually and speedily secured; and secondly, that the ligatures may be withdrawn with so much facility as not to interfere, in the slightest degree, with the adhesive process. These advantages are, it is obvious, altogether chimerical, for this puckering of the bowel, instead of promoting the apposition of the edges of the wound, as is contended by Le Dran, has the effect of separating them from each other, and thereby increasing the danger of fæcal effusion. The removal of the ligatures, notwithstanding the ease with which it is accomplished, must also have a tendency to break up the tender adhesions of the part, if not to excite undue irritation in the peritoneum. Besides these objections, which are in themselves sufficiently serious to prevent any future recourse to this method of treatment, it is alleged that it is almost always followed by such a diminution of the caliber of the alimentary canal as to interfere essentially with the passage of its contents. Mons. Velpeau, in his Surgical Atlas, has delineated this suture, but whether with the design that it should be adopted in practice, or as a piece merely of scientific curiosity, I am unable to say. He has not made any special mention of it in connexion with the subject in his "*Médecine Opératoire*."

5.—*Method of Bertrandi, or "La Suture à Points Passés."*

Another method, which appears to have been a good deal employed at one time, was devised by Bertrandi, and is usu-

ally described by the French writers under the phrase of “la suture à points passés.” It differs from the continued suture merely in having all the loops laterally, and in drawing together only the internal lips of the wound, the outer remaining apart; or, in other and more simple language, the ligature is passed through, not over the margins of the solution of continuity, as in the common operation. The method of Bertrandi has been advocated by Sabatier, Desault, Boyer, and several other surgeons, though they have not, I believe, adduced any facts in illustration of its efficacy. Boyer says* that it possesses the advantage of keeping the edges of the wound together and of promoting their adhesion with the surrounding parts, at the same time that it does not occasion any puckering of the bowel, or diminution of its caliber; and for these reasons he seems to be inclined to give it a preference over other procedures.

The “suture à points passés” is performed with a round, straight needle, armed with a waxed thread. As a preliminary step, the surgeon adjusts the edges of the wound, placing them parallel and in close contact with each other. For this purpose he takes hold of one extremity of it himself, and intrusts the other to an intelligent assistant. The needle is then carried somewhat obliquely across the lips of the opening, about the fifth of an inch from its extremity: having done this it is brought back in the same manner, and thus it is passed alternately from one side to the other until the whole track is closed up, the operation being similar to that employed by a tailor in sewing together two pieces of cloth. The interval between the respective stitches should not exceed two lines, or the sixth of an inch, otherwise fæcal matter may escape into the abdomen. The intestine being replaced, the extremities of the suture are brought out at the external opening, where they are secured by a strip of adhesive plaster. In a few days one of them should be cut off close to the wound, and the other gently

* *Maladies Chirurgicales*, T. 7, p. 379.

pulled to promote its separation. Some of the successors of Bertrandi recommend that the ligature should be passed through the edges of the outer orifice, to prevent the bowel from slipping out of the reach of the surgeon; a precaution which can only be necessary when the patient is very young or restless.

To obviate the danger of destroying the feeble and imperfect adhesions of the intestine, incurred in withdrawing the suture in the manner suggested by Bertrandi, it occurred to B  clard that it might be advantageous to use two ligatures, one white, the other colored. The mode of performing the operation does not differ in other respects from that which we have just described. When the time for removing the threads has arrived, the surgeon withdraws them in opposite directions, taking hold of the white one, for example, with the left hand, and of the colored with the right. The result of this traction is that the adhesive process is scarcely at all disturbed, while the reverse must always happen when the suture is detached in the manner recommended by Bertrandi.

With the exception of Boyer, I do not know that the method of Bertrandi has any advocates at the present day. I have not tried it upon any of the inferior animals, and we are not in possession of any facts which warrant its employment in the human subject.

6.—*Method of the Four Masters.*

The method of the four masters—“*Quatre Maitres*”—as it is termed, which is usually attributed to Duverger, who was the first to revive it after it had fallen into neglect, consists in stitching the divided ends of the bowel over a piece of trachea, either of the calf or of some other animal. What the precise length of the tube was I am unable to say, but in all probability it did not exceed two inches. In its diameter it was a little smaller than the alimentary canal, into which it was intended to be introduced, and previously to

using it it was well dried and varnished, to prevent it from too readily imbibing moisture. Three ligatures were passed through it equidistant from each other, and armed each with a small curved needle. The piece of trachea thus prepared was inserted into the ends of the bowel, where it was secured by three interrupted sutures made by passing the needles from within outwards, about three lines from the edges of the wound, which were held together by an assistant. The ends of the threads were cut off close to the knots, and the parts reduced by pushing the lower end in first.

This method of the four masters is said to have been successfully employed by Duverger in a case of strangulated hernia, in which a part of the bowel was affected with gangrene.* In the account of this process, as given by Dupuytren, in his *Treatise on Gun-shot Wounds*,† the inferior extremity is directed to be drawn nearly half an inch over the superior, placing thus, as in the operation of Ramdohr, a mucous surface in contact with a serous. The surgeon, also, is made to use a single suture, instead of three, as stated above, and the upper end of the gut is to be carefully distinguished from the lower.

This method, slightly modified, was successfully employed by Sir Astley Cooper upon a dog. He used a cylinder of isinglass instead of a calf's trachea, upon which he made three sutures, one at the mesentery, and another at each side of the bowel, which was then returned into its natural situation. In three days the animal took food, had regular stools, and on the sixteenth day he was killed, when the united parts were shown by Sir Astley to his students. No advantage appeared to result from the cylinder of isinglass, as it became shut by the contraction of the intestine, and the experiment was therefore never repeated.‡

* Dict. de Med. et de Chir. Pratiq., T. 13, p. 267.

† T. i., p. 191.

‡ On Hernia, p. 51.

Sabatier proposed, as a substitute for the piece of trachea, recommended by the four masters, a roll of paste-board, which he advised to be well varnished with oil of turpentine, or some other tenacious fluid, and fastened to the bowel with a single stitch. Watson, an English writer, speaks favorably of a canula of isinglass. Some of the older surgeons were in the habit of employing a tube of elder-wood; others a piece of tallow candle. Rogers, Garnier, and Théodore recommend the use of the elder-wood to defend the suture from the injurious effects of the fæcal matter, of which they appeared to have much dread.

The method of the four masters, somewhat modified, is warmly advocated by Chopart and Desault, in their *Treatise on Surgery*. The improvement which these two distinguished men suggested, but which was never, I believe, carried into effect by them upon the human subject, consists in passing two fine needles, armed with a silk ligature, twelve inches long, through the centre of the paste-board cylinder, and bringing them out respectively three lines above and below their place of entrance. The ligature will thus be found to be attached to the artificial tube, without crossing its cavity, or interfering in any wise with the transmission of fæcal matter. The two needles are next carried through the upper part of the bowel, equidistant from each other, and at a point from the wound equal to the half of the length of the cylinder. The latter is now to be engaged in the upper portion of the intestine, after which the lower end is to be pierced in the same manner, but a little farther from the seat of the injury, and the remainder of the tube to be introduced along with five or six lines of the inferior extremity of the gut. Should this invagination be attended with much difficulty, on account of the mesentery, the latter should be detached to the requisite extent, and the operation finished in the manner already stated, care being taken to tie any obstinately bleeding vessels. The parts, when returned, should be kept in exact apposition with the external wound, to promote their adhesion, an object which may be readily accomplished

by securing the ends of the ligature to the surface of the abdomen.*

7.—*Method of Palfin, Bell, and Scarpa.*

J. Palfin, author of the “*Anatomie Chirurgicale*,” thought it of much less importance to sew up the wounded intestine than to stitch it to the wall of the abdomen. In conformity with this belief he advises the surgeon to carry a waxed thread, armed with a needle, through the edges of the solution of continuity at their centre, and after tying it into a simple slip-knot, to bring the ends out at the external opening, where they are to be secured by an adhesive strip. He entertained the singular notion that the divided ends never united with each other, but that the cure was effected solely by the adhesions which they formed to the surrounding parts. This plan, which certainly possesses the merit of great simplicity, he considered as equally applicable to transverse and longitudinal wounds.†

This method of the old French surgeon found a warm advocate in that great luminary of the profession, the late Mr. John Bell, who, however, does not appear to have been aware that it had been previously recommended; at all events, he has not any where alluded to Palfin or his writings in connexion with the subject. Like his Gallic predecessor, he suggests that only a single stitch should be taken, and that the thread should be brought out at the external opening; adding, in his own expressive language, that if there be in all surgery a work of supererogation it is this operation of sewing up a wounded gut.‡ This plan he advises not only where there is a simple slit-like aperture in the bowel, the

* Tavernier’s *Operative Surgery*, translated by the author, p. 276. Phila. 1829.

† *Anatomie Chirurgicale*, T. ii, p. 76. Paris, 1743.

‡ *Discourses on the Nature and Cure of Wounds*, vol. ii, p. 80. Walpole, N. H., 1807.

kind of injury most commonly met with, but where it is divided in its entire cylinder. He is of opinion that it is only necessary to keep the wound of the intestine neatly and closely in contact with that in the wall of the abdomen, when the parts will gradually adhere, affording at the same time an opportunity for the escape of fæcal matter. He contends that sewing up the breach in the intestine firmly with a needle and thread is absurd, and that the mere pressure upon the abdominal viscera will keep the edges of the wound so close to the peritoneum as to insure their re-union. But is this the practice generally pursued by surgeons, or, rather, is it not universally abandoned, for the sufficient reason of its entire inadequacy? If there ever was an error committed by any writer more serious, culpable, and mischievous than another, it is most assuredly this of Mr. John Bell, who while criticizing and condemning, in no measured terms, the advice and practice of others, has himself fallen into a most strange delusion. Had he performed the operation in a single instance upon the human subject, or upon an inferior animal—an experiment from which he affects so much to shrink—he would have become fully sensible of its danger and insufficiency. That the operation, as recommended by this eminent surgeon, might occasionally be attended with success is not improbable, but that it should not be trusted to in the present enlightened state of the healing art must be obvious to all who will be at the trouble to investigate it. Independently of the great risk of fæcal effusion into the peritoneal cavity, there are few cases, if any, in which it would not be followed by an artificial anus, an occurrence which need never attend enterorraphy when performed in the manner previously pointed out.

Although both Smith and Travers had already exposed the insufficiency of this mode of procedure, I was determined, if possible, to throw additional light upon it, and with this view instituted several experiments, the results of which, as will be here seen, fully confirm those of the above investigators.

EXPERIMENT I.—Having obtained a small slut, a fold of the ileum was drawn out of the abdomen, and divided through its entire cylinder. A single stitch was then carried through the everted edges, at the point opposite to their attachment to the mesentery, when the ends of the ligature were tied and left protruding at the external orifice, which was secured in the usual manner. In thirty-five hours the animal expired, having in the meanwhile suffered severe pain and refused such food as was offered her. The opening of the abdomen was followed by the escape of a considerable quantity of fœtid gas; and the peritoneal sac, which exhibited marks of high inflammation, contained more than an ounce of fluid and solid fæces. The edges of the wound were red, besmeared with thick and ropy mucus, and at least three lines apart at the widest portion of the breach. No attempt at reparation was visible.

EXPERIMENT II.—The above experiment was repeated upon a small but full-grown dog, which died in twenty-four hours after the operation. A considerable quantity of thin alvine matter was found in the abdomen, as in the preceding case, the peritoneum was extensively inflamed, several coils of intestine adhered slightly to each other, and the lips of the wound were deeply injected, with marked eversion of the mucous membrane, but no incrustation of plastic lymph. It is worthy of remark that, neither in this nor in the preceding experiment, was there any discharge of fæces through the external wound.

EXPERIMENT III.—A young dog of moderate size was submitted to the same experiment as the two preceding, with this difference, that the incision passed only through two-thirds of the intestine, producing a wound about an inch and three-eighths in extent. For the first twenty-four hours he was apparently well, being lively and cheerful, but afterwards symptoms of indisposition came on, and he died early on the third day. The lips of the wound, red and injected, were separated fully a line and a half at their middle; semi-fluid fæces with some water which the animal had drank, had

escaped into the abdomen, and the peritoneum, especially in the vicinity of the injury, displayed strong marks of inflammation. The external wound had a red angry appearance, from the passage, no doubt, of fæculent matter, which was discharged through it for ten or fifteen hours before death.

In an experiment of this kind performed by Mr. Travers,* the animal survived only a few hours. The peritoneum appeared highly inflamed, adhesions existed among the neighboring folds, and lymph was deposited in masses upon the sides of the injured gut. A quantity of bilious fluid was found among the abdominal viscera together with some other extraneous substances, and a worm was depending from one of the apertures of the gut, which had receded to the utmost and were of a circular form.

In three experiments by Dr. Smith† instituted with a view of ascertaining the merits of Mr. Bell's treatment, one of the dogs died at the end of the first day, the other on the fifth day, and the third on the seventh day. In all, the bowels were very much inflamed, from the effusion of fæcal matter into the peritoneal sac. In one of the animals, that namely which lived longest, one part of the injured intestine had contracted adhesions to the external wound, allowing thereby a slight discharge of fæces in that direction.

Thus, in seven experiments, all conducted, there is reason to believe, with the requisite care and skill, not a single one had a favorable termination. Nor is this surprising when we consider the circumstances which invariable attend lesions of this description; we have already seen that punctures of the bowel, more than a third of an inch in length, are almost constantly followed by fæcal extravasation, and the same thing it will be recollected is apt to happen in more extensive wounds treated with the interrupted suture, when the interval between each two respective ligatures exceeds three or four lines. That Mr. Bell should have committed

* Op. cit., p. 116.

† Caldwell's Medical Theses, p. 296.

such an error is not to be wondered at when we remember the period at which he wrote; he instituted no experiments on any of the inferior animals to elucidate the subject, and the beautiful researches of Travers, Thomson and Smith had either not been made, or no notice of them had appeared. He sinned, therefore, because he had not the requisite light to guide him. But it is otherwise with Professor Cooper, of London.* In sanctioning, as he does, the practice of John Bell, he is instrumental in perpetuating an error for which modern surgery can find no excuse, and which deserves to be reprobated in the strongest terms, from the pernicious tendency which it must exert upon the younger members of the profession when inculcated by an authority so respectable and influential.

Professor Gibson, of Philadelphia, appears to be disposed to advocate the same kind of practice.† “Should a case present itself” says he, “which, from the extent of the wound and other circumstances, seemed to require a suture, I should be inclined to follow the plan of Mr. Bell, and simply employ one or more tacks of the *interrupted* suture, merely for the purpose of connecting the wound in the gut slightly to the external wound.”

Mr. Syme, professor of Clinical Surgery in the University of Edinburg, in speaking of the treatment of wounds of the bowels, involving their entire cylinder, holds the following language:‡ “If the whole circumference of the gut is divided it may be best to insert only one stitch on the side next the mesentery, so as to keep the two mouths of the intestine together, and then retain the aperture of the canal in correspondence with the external wound, by means of threads passed through their respective edges. A preternatural opening for the discharge of the bowel must thus in all probability be formed in the first instance; but the immediate danger

* First Lines of Surgery, vol. ii, p. 74.

† Institutes of Surgery, vol. i, p. 119. 1833.

‡ Principles of Surgery, p. 303, third edition, 1842.

will be diminished, while room is afforded for subsequent reparation."

Still more extraordinary and unaccountable is the plan of procedure proposed by Professor Scarpa, of Italy.* This celebrated surgeon has offered a variety of arguments against sewing up the wound at all, and asserts that in all cases of injury of the intestinal canal, whether the opening be longitudinal or transverse, a suture is always not only useless, but even dangerous and fatal. Great evils, he thinks, arise from the passage of the ligatures, however few, across the delicate and sensitive tunics of the bowels, which are thus exceedingly apt to become inflamed, and to propagate the morbid action rapidly to the surrounding viscera. He affirms that the experience of several ages clearly proves that nearly all who have been subjected to enteroraphy have died in the severest agony, and that the few who have recovered have escaped not in consequence of the operation, but in despite of it. I do not deem it necessary to enter into any formal refutation of these singular views of the illustrious professor of Pavia. I must only express my surprise that they should have been entertained and promulgated after the publication of the researches of Mr. Travers, which shed so much light upon the subject, and so emphatically inculcate the indispensable importance of the suture in all wounds of the intestines, even when of comparatively small extent. It is one of those remarkable circumstances which not unfrequently occur in our profession, and which can only be explained by a reference to the infirmities and prejudices of our nature. The case of Scarpa is on a par precisely with that of John Bell. When this eminent surgeon was at such pains to criticize and condemn the practice of his name-sake, Benjamin Bell, of Edinburgh, in regard to the present topic, he had probably little idea that the verdict of the profession would, in less than a quarter of a century, entirely reverse

* Treatise on Hernia, translated by Wishart.—Cooper's First Lines of Surgery, vol. ii, p. 71.

his decision, and treat him as unsparingly as he did his Scotch cotemporary.

S.—*Method of Jobert.*

Another mode of treating wounds of the intestines, involving their entire circumference, was proposed in 1822 by Mons. A. J. Jobert, of France, well-known as the author of a very valuable and elaborate treatise on the surgical diseases of the alimentary canal. It is founded on a series of experiments on dogs, and has recently been employed in several instances upon the human subject. The operation is divided into three stages, and the apparatus required for executing it consists of: 1. A pair of probe-pointed scissors; 2. A pair of dissecting forceps; 3. Two double ligatures, carefully waxed, rounded, and from six to eight inches long; 4. Four common sewing needles; 5. Several curved needles for stitching up the outer wound; 6. Sponges, warm water, pledgets of lint, adhesive plaster, square compresses, and a broad bandage.*

The patient, lying on his back near the edge of the bed, is placed in the most favorable manner for the thorough relaxation of the abdominal muscles. The prolapsed bowel is then washed with tepid water, and the edges of the wound, if ragged and bruised, are pared with the scissors. The next step is to dissect off the mesentery for several lines from each end of the injured gut, an operation which is commonly attended with some degree of hemorrhage, which has a tendency, however, to moderate the subsequent inflammation. When very profuse, it may become necessary to secure the divided vessels with temporary ligatures, which are to be removed before the parts are replaced into the abdomen. This constitutes the first stage of the operation.

The second stage consists in the introduction of the needles. To accomplish this the surgeon seizes the upper end

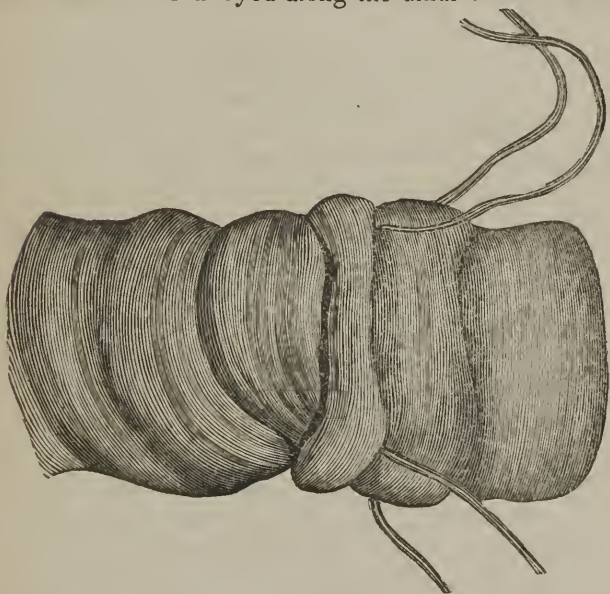
* *Traité Theorique et Pratique des Maladies Chirurgicales du Canal Intestinal*, par A. J. Jobert; T. i, p. 88. Paris, 1829.

with the left hand, while with the right, in which he holds a thread armed at each extremity with a straight and moderate sized needle, he traverses the anterior wall of the intestine from within outwards, at the distance of three lines from the edge of the wound, so as to form a loop with its convexity upwards, and which is now to be intrusted to an assistant. A second thread is then carried in the same manner through the corresponding part of the posterior wall, when the operator, either with his fingers or with a pair of dissecting forceps, inverts the coats of the lower end, and so places the serous surface within the tube. At this moment



there is apt to be some contraction of the intus-suscepted parts, which may be allayed, if necessary, by applying to them a weak solution of opium.

Having effected the inversion of the lower end, the surgeon introduces into it the index-finger of the left hand, for the double purpose of preventing it from unfolding itself, and of serving as a guide to the needles. With the thumb and fore-finger of the other hand, he now seizes the two needles of the anterior thread held at the same level, and carrying them along the radial margin of the finger which is in the lower end, he pierces its anterior doubled wall from within outwards, the instruments being brought out at the distance of a line from each other. The needles attached to the posterior thread are conveyed along the ulnar border of the fin-



ger, and made to traverse the bowel at a point opposite to the preceding. Then, approximating the injured parts as closely as possible, he withdraws the finger, and gently pulling at the threads, thus gradually introduces the upper end into the lower. The invagination may be facilitated, if necessary, with any smooth, round body. Having restored the bowel to the abdomen, the ligatures are twisted together and placed at the inferior angle of the external wound, which is cov-

ered with adhesive strips, a compress and a bandage. On the fourth or fifth day, when the union is said to be sufficiently firm, the threads are withdrawn.

The object of this method is to bring the two serous surfaces of the bowel into contact with each other, and thus promote their re-union. Jobert states that he found in his experiments upon dogs, at the expiration of the twelfth day, a linear cicatrice indicating the place of adhesion between the two ends of the gut, unaccompanied, in the majority of cases, by any particular dilatation of the upper one. Internally there was a sort of artificial valve, the result of the invagination, which floated about in the tube, and formed an inclined plane which allowed a free passage to the alimentary bolus. The mucous membrane appears to have been uninterruptedly continuous. In the five dogs upon which this operation was performed by Jobert, perfect recovery took place. There was no serious disturbance in the functions of the animals, not even in that of defecation.*

There are, I believe, only two cases on record in which this course of proceeding was attempted on the human subject. The first is that recently communicated by Mons. Julius Cloquet to the Royal Academy of Medicine of Paris.† The patient was affected with strangulated hernia, attended with mortification of the entire cylinder of the intestine. After having cut away the whole of the sphacelated parts, Cloquet invaginated the divided extremities, and maintained them in apposition by the method of Jobert. As soon as it was ascertained that nothing escaped from the tube on pressure, the bowel was returned, and the abdominal wound secured in the usual manner. When the case was reported fifteen days had elapsed since the operation, without the occurrence of any untoward symptoms, and with the prospect of a speedy cure.

The other case fell under the observation of Professor Berard, who presented an account of it, a few years ago, to the Anatomical Society of Paris. He was called to a female

* Op. cit. p. 91-'2-'3.

† Archives Generales, T. xi, 648.

who, in a paroxysm of mania, cut off two feet of her small bowels. He treated the case according to the process of Jobert, but death occurred in thirty-six hours without the slightest adhesion between the contiguous surfaces.*

The method of Jobert was modified, soon after being made known, by Julius Cloquet, the distinguished anatomist and surgeon. Instead of inverting the lower, and introducing the upper end, he advises simply to pass the needle through the walls of the intestine, a few lines from the division, and to draw the lips of the wound against each other, until the serous surfaces are brought fully into contact. To maintain them in this situation several sutures are required, the ends of which are to be cut off near the knots, when the bowel is returned, and the operation completed.†

Finally, Jobert has proposed the following expedient,‡ which, it appears, he has also employed with success in his experiments on the inferior animals, though he has not tried it on the human subject. Taking care to distinguish the extremities of the divided gut from each other, he traverses the anterior wall of the upper with a silk thread armed with two needles. Both needles are then carried to the inferior end, and passed separately through the anterior wall from within outwards, when by gentle tractions the operator inserts the extremities into each other, to the extent only, however, of about one line and a half to two lines, without any previous introversion of their edges. The needles are now to be given to an assistant, when, taking another, which should be exceedingly fine, and armed with a very delicate thread, he plaits the serous membrane of the upper end, and afterwards that of the lower. The ligatures are to be tied with a double knot, in such a manner as to invert the inferior extremity, or turn it in upon itself, and thus bring the serous surfaces in apposition with each other. The ends are left hanging out at

* London Medical Lancet for 1835-'6, p. 45.

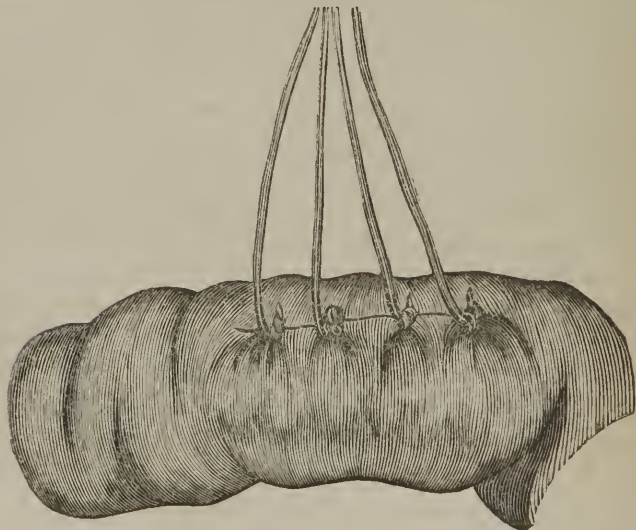
† Jobert, *op. cit.* T. i, p. 93.—Tavernier's Operative Surgery, translated by the author, p. 277.

‡ *Op. cit.* T. i, p. 93.

the external wound. Three sutures made in this way are generally sufficient to preserve the relations of the parts.

Jobert does not consider this method applicable to young subjects, on account of the great fragility of the serous membrane and the facility with which it is torn. Lately, however, he employed it upon a pup with the most perfect success; the animal speedily recovered, and the functions of the digestive canal were executed with their accustomed vigor.

In longitudinal wounds, Jobert employs a procedure very similar to that of Lembert, described in the next section, that is, he inverts the edges, and keeps them in contact by several points of the interrupted suture. The ligatures should be placed so near each other as not to permit any protrusion of the mucous membrane, or, what is the same thing, they should produce, when tied, the most perfect apposition of the serous surfaces. The extremities of the sutures may be twisted together and brought out at the external orifice, as in the method of Le Dran; or, what is preferable, they may be



cut off close to the knots, or left hanging out separately. In the former case, they will fall into the cavity of the bowel;

in the latter, they may be pulled away at the end of five or six days.*

I subjoin the following experiments in illustration of Mons. Jobert's first method.

EXPERIMENT I.—On the 28th of May, assisted by Dr. Cole-scott, Dr. Hagan, Mr. Mullen, and Mr. Church, I divided the ileum of a small young dog, and inserted the superior into what was supposed to be the inferior end. The operation was exceedingly difficult and perplexing, nearly half an hour elapsing before it was completed. With all the skill I could command it was impossible to make the ends firmly meet in their entire circumference. No vessels required to be tied. The gut was carefully returned, and the extremities of the two ligatures were brought out at the abdominal wound, which was closed in the usual manner. The animal vomited several times soon after the operation, and refused to take food on the following day, but not water, which he drank with avidity. Late on the third day he died.

The dissection disclosed the following appearances. About two ounces of sero-purulent fluid were contained in the peritoneal sac, which exhibited marks of high inflammation in the greater part of its extent. The omentum covered, and adhered to, the whole of the intestinal convolutions. The small bowels were completely matted together—the lips of the wound were in contact but not invaginated—and the continuity of the tube was established externally by plastic lymph. The ligatures still retained their situation. No fæcal matter was discoverable in the effused fluid, and it was evident that the peritonitis, which destroyed the animal, had been induced by the violence inflicted upon the gut in my efforts to invaginate the divided extremities.

EXPERIMENT II.—Immediately after the last experiment I repeated the method of Jobert upon another dog, somewhat larger than the former, and succeeded, after much

* Malgaigne, Manuel de Medecine Operatoire, p. 531. Paris, 1837.

difficulty, in effecting the invagination. The operation occupied fully thirty-five minutes; it was exceedingly painful, and one of the ligatures lost its hold so much that I was obliged to remove and re-introduce it. Several of the mesenteric arteries bled rather freely, but did not require to be secured. The dog suffered considerably for the first three days, after which he became more lively, and continued so until the fifth of June, when he evinced symptoms of severe indisposition, under which he succumbed on the seventh, the experiment having been performed on the 28th of May. He took food only a few hours before. The ligatures escaped on the fifth day.

The abdominal wound was nearly cicatrized with a small plug of omentum interposed between its lips. The peritoneum exhibited no unnatural redness or vascularity. The small bowel, for about three feet and a half, was enormously distended with gas and fæcal matter, being at least five times as large as in health; its coats were thin, soft, and easily torn; and the mucous membrane was highly inflamed in patches varying in size from a dime to that of a Spanish dollar. The wound was situated near the ileo-cæcal valve with a mass of omentum and the ascending colon intimately adherent to its outer surface. On laying open the tube it was found to be completely obstructed, the inferior end, which was the invaginated one, having become firmly united to the inner surface of the upper, into which it projected in the form of a mammillated protuberance, six lines in length, tapering at its free extremity, and perfectly closed. The part of the small intestine which intervened between the wound and the ileo-cæcal valve was slightly diminished in its caliber, as was also the entire colon: the latter contained scarcely any fæcal matter. In the stomach was a small quantity of undigested food. All the other abdominal viscera were sound.

Such were the results of the above experiments, which are all I have performed with a view of testing this method. It may be supposed that they are not sufficiently numerous to

entitle me to deduce from them any general conclusions. I think otherwise. Independently of their unfavorable termination, the difficulty which attended their execution would be enough to deter me, under any circumstances, from resorting to it in the human subject. A practitioner may err through ignorance, but when he does so designedly or despite the most abundant light, neither his own conscience nor the voice of the profession will excuse him. If the method of Jobert were the only expedient of the sort, we might be justifiable in employing it; but, when there are so many others which are all decidedly superior, we should be aware how we give it our sanction. As it is, I do not hesitate to denounce the proposal as unnecessarily harsh in its execution, uncertain in its results, and altogether unwarrantable in the present state of our knowledge. Of the improvement suggested by Cloquet I have no personal knowledge; nor can I say any thing more definite of Jobert's other expedient, described in a preceding page, and which appears to be merely a modification of that of Lembert.

9.—*Method of Lembert.*

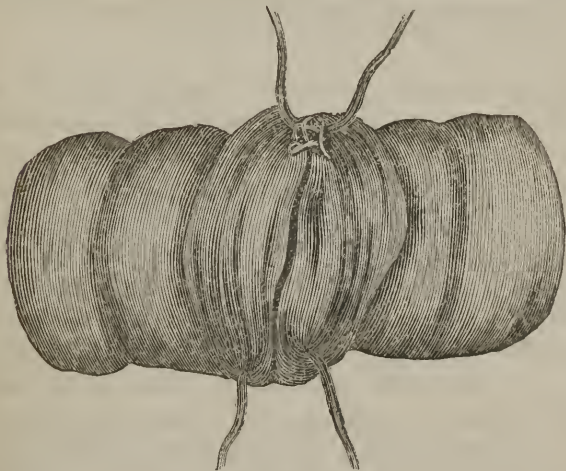
A very ingenious process of sewing up a wounded intestine, now to be noticed, was proposed in 1825, by Mons. Lembert of Paris, in the second volume of the "*Repertoire Generale d' Anatomie et de Physiologie Pathologique.*"* The number of needles to be employed must correspond with the number of sutures designed to be made; they should be long, slender, and armed each with a small but strong and well-waxed thread. The drawings will fully explain the nature of the operation, which is performed in the following manner. A short stitch, including only the peritoneal



and muscular coats, is to be taken up on one side of the wound, distant about a quarter of an inch from its edge;

* London Lancet, vol. xi, p. 848.—Johnson's Medico-Chirurgical Review, vol. xxi, p. 299.—Velpeau, *Medeciné Operatoire*, T. 4, p. 137.—Vidal, *Traité de Pathologie Externe et de Medecine Operatoire*, T. 4, p. 506.

the needle is then carried across the solution of continuity, and a similar stitch taken up on the opposite side: in this way one suture is to be placed after the other, the interval between each two varying from three to four lines, and when they are all arranged they are to be drawn firmly together and tied with a double knot. By this proceeding, the incision is completely closed,* the serous surfaces are intimately



approximated, and the lips of the wound are inverted or turned inwards, forming a kind of valve, about the twelfth of an inch long, within the tube. The ends of the threads being cut off near the knots, the bowel is returned into the abdomen as near as possible to the outer opening, and the case treated as under ordinary circumstances. Mons. Lemberth has observed that the sutures usually escape into the cavity of the gut by the seventh or eighth day, after having cut through the parts which they embraced by ulcerative action, and that the plastic exudation which serves as a bond of union between the wounded and the adjacent textures, becomes very quickly organized, and remains a considerable period before it is absorbed.

* The edges of the wound, it will be observed, are only partially united in the drawing, as there are only two sutures, which are not adequate to effect complete apposition and inversion.

Cases are reported in which the proceeding here described is said to have been successfully employed, not only in the inferior animals, but in mortified hernia and wounds of the intestines of the human subject. I subjoin the following, being all I can find upon record.

CASE I.—Strangulated congenital hernia of the left side—patient forty-one years of age—bowel accidentally wounded in dividing the stricture—opening an inch and a half long—two sutures—recovery in a month.

This case, related by Jobert, occurred in the hands of Professor J. Cloquet, and is the first of the kind on record.* Nicholas Lejeune, forty-one years of age, of middle height and spare habit, entered the St. Louis hospital of Paris, on the 13th of July 1826, with a strangulated congenital hernia of the left side, for which he had always been obliged to wear a truss. The tumor, which was of large size, was soft and fluctuating, the patient was affected with nausea and occasional vomiting, the pulse was small and frequent, the thirst urgent, the breathing hurried and interrupted, and the abdomen extremely sensitive, with great prostration of strength. Every attempt at the taxis having failed, Cloquet proceeded to perform the operation. The portion of bowel included in the swelling was highly inflamed and enormously distended. The stricture was formed by the neck of the sac. This was divided with the bistoury, when he tried to effect reduction but failed. The instrument was therefore introduced a second time, to enlarge the incision, and as he was

* This case is published by Jobert, (*op. cit.* T. i, p. 280,) as having been treated according to his own method, a circumstance which may be explained by the fact that he claims to be the discoverer of the process above mentioned, and now usually attributed to Lambert. Indeed, the question of priority does not seem to be fully decided; but as this does not impair the merits of the operation, we shall not stop to settle it one way or the other. Mr. Lawrence, (*Treatise on Ruptures*, p. 306,) who quotes the case from Jobert, says it was treated according to Lambert's method; and Velpeau, (*Médecine Opératoire*, T. iv, p. 143, evidently considers it as an example of that kind.

withdrawing it a portion of the intestine, held by one of the assistants, was accidentally opened to the extent of an inch and a half, followed by an escape of gaseous and fæcal matter. With a common needle he immediately sewed up the wound, entering it four lines from the cut edge, and bringing it out at about one line: having carried it in the same manner through the other side, he easily inverted the margins of the aperture, and thus approximated the serous surfaces. Having placed two sutures, he fastened them with a double knot, and, satisfied that nothing escaped, cut off the ends close to the bowel, which he now pushed into the abdominal cavity. Simple dressings were applied to the outer wound, and secured by a T bandage. All the unfavorable symptoms rapidly disappeared, and the man left the hospital cured on the 12th of August.

CASE II.—Patient fifty years of age—strangulated crural hernia of the right side—excision of three inches of mortified bowel—number of sutures not stated—death in five or six weeks from the use of indigestible food.

The second case in which this method of enteroraphy was attended with a favorable result, occurred a few years ago in the practice of Professor Dieffenbach, of Berlin.* The patient, a strong, tall husbandman, fifty years of age, had suffered for fifteen days from strangulated crural hernia of the right side. Various attempts had been made at reduction, but without success, by other surgeons, and the probability was that the constricted parts had sloughed, and given rise to

* This case was originally published in the "*Wochenschrift für die gesammte Heilkunde*," Nov. 26, 1836. The British and Foreign Medical Review (vol. iii, p. 517,) in noticing the case, states that the strangulation existed only fourteen days, and that it was inguinal, not crural hernia. Mr. Lawrence (Treatise on Ruptures, p. 362,) however, who obtained his information from the "*Archives generales de Medecine*" for March 1837, makes out the case to have been one of crural hernia, and so does the writer in the London Lancet for June of the same year, and who translated his article from Græfe and Walther's Journal, vol. xxiv, No. 3.

an effusion of fæcal matter. This, indeed, was found, on laying open the swelling, to be the case. The fold of intestine contained in the sac presented, near its upper part, an aperture large enough to admit the thumb. As the fæces did not readily escape, even after the division of the stricture, owing partly to the narrowness of the hernial opening, and partly to the constriction of the gut, the operator destroyed the preternatural adhesions and drew the canal for some distance out of the abdomen. He then excised the whole of the mortified portion, which was at least three inches in length. The corresponding part of the mesentery was removed with a pair of scissors, and a small artery, which was divided in this step of the proceeding, was secured with a ligature, the extremities of which were cut off close to the knot. The open ends of the bowel, which were held by assistants, contracted to such an extent that they would not admit any thing larger than a writing-quill, and the mucous coat was everted. Having united the angular wound of the mesentery with a very fine thread, the lips of the intestinal breach were treated according to the process of Lembert, when the parts were gently replaced within the abdomen. Shortly afterwards castor-oil was administered in large quantities, which was subsequently repeated with croton-oil, and the patient was ordered to remain for sometime on his feet: copious evacuations ensued, with great improvement in all the symptoms. For a few days the treatment was mildly antiphlogistic, and the only remedy given was some castor-oil in laurel-water. The stools soon became natural, the external wound discharged healthy pus, and in a month the patient was so well that he was able to resume his occupation.

The man continued in excellent health for several weeks, when, after severe labor in the field, and the use of very indigestible food, he was suddenly seized with violent pain in the abdomen, vomiting and constipation, under which he died. Two diseased conditions were found within the abdomen. In the left lumbar region a portion of small bowel had coiled around another portion, which it had thus strangulated: above

this point the ileum and jejunum were much inflamed, adherent, covered with flakes of lymph, and distended with excrementitious fluid, which was also found in the duodenum and stomach. The gut below the seat of the strangulation was empty and contracted, descending in this state in front of the lumbar vertebræ on the right side, where several convolutions were closely adherent to the walls of the abdomen and to each other. In detaching them, a few drops of pus escaped, and a knot of silk was met with, indicating the exact spot at which the ligature had been inserted, and consequently the place where the tube had been divided. On cutting it open, the parts were found to be united through the medium of a smooth, even cicatrice, half a line broad, and interrupted merely at two points by so many threads, which were still adherent to the surface. There was no perceptible contraction of the caliber of the tube.

CASE III.—Accidental wound of the intestine in operating on crural hernia—patient fifty-four years old—two sutures with the ends twisted together and brought out at the external opening—complete recovery.

A third successful example of Lembert's process has been recently published by Mons. Fleury, in a valuable memoir on intestinal sutures in the "*Archives Générales de Médecine*" for March 1837. In operating on a crural hernia, in a lady fifty-four years of age, a wound was accidentally inflicted on the intestine, which was obscured by adhesions. When the latter had been destroyed, a portion of gut was drawn out of the abdomen, exhibiting a deep mark from the pressure of the crural ring. Mons. Jobert, the operator, determined to close the cut in the intestine by sutures applied in the manner already described, which he accordingly did.* The threads being then united, gentle torsion was made which brought the external edges of the wound together, and placed the serous surfaces in apposition. The bowel was then returned, the ends of the ligatures were left hanging through the outer opening, where they were secured by adhesive plaster, and

* See page 116.

ordinary dressing was applied. The symptoms immediately assumed a more favorable aspect, the bowels acted well on the fourth day, one of the ligatures was withdrawn on the sixth, and the other on the eighth day, and in a month the wound in the abdomen was perfectly cicatrized. At the end of the third month the patient was in excellent health, the functions of the alimentary canal being performed without any irregularity or impediment.*

CASE IV.—Gunshot wound of the arch of the colon—three sutures—the ends of the ligatures cut off close to the knots—complete recovery.

A soldier, whose case is mentioned by Mons. Baudens,† was wounded by a ball, which entered three inches to the left of the umbilicus, and passed out at the back not far from the spine. A finger conveyed into the wound readily discovered a large opening in the arch of the colon, which was accordingly drawn out of the abdomen; the edges of the fissure were inverted, and maintained by three points of suture, introduced in accordance with Lembert's method, the ligatures being cut off close to the knots. The man was bled several times at the arm soon after the accident, and subsequently the abdomen was covered with leeches. Under this treatment he rapidly recovered.

Finally, Velpeau alludes‡ to a fifth case in which this operation was attended with favorable results in the human subject. It fell under the observation of Liégard, a French surgeon, but I am not in possession of the particulars.

In the following cases, in which the method of Lembert was employed, death was produced, in two, by causes apparently unconnected with the operation, and in the third by peritoneal inflammation. The two first, which both occur-

* British and Foreign Medical Review, vol. iv, p. 512.—Lawrence on Ruptures, p. 307.

† Clinique des Plaies D'Armes et Feu, p. 336. Paris, 1836.

‡ Médecine Opératoire, T. iv, p. 143.

red in the practice of Mons. Jobert, I shall relate as detailed by Mr. Lawrence in his *Treatise on Ruptures*.

CASE I.—Two incised wounds, one transverse, the other longitudinal, the first being united by four, the second by eight points of suture—the ends of the ligatures brought out at the external opening—the patient twenty-three years of age—death in thirty-eight hours from fæcal effusion.

A man, twenty-three years of age, was stabbed in the abdomen with a knife, cutting a portion of intestine, which protruded at the wound, in two places. One of the apertures was transverse, and ten or twelve lines in length; the tunics being completely divided only to the extent of about two-thirds of an inch. It was united by four points of suture, with a common needle and a single thread, carried through the parts in the manner above mentioned. The extremities of the ligatures were then twisted together, which had the effect of approximating the margins of the incision by their external surfaces, and consequently of bringing the opposed serous membranes into contact with each other. These threads were next held by an assistant, while the longitudinal wound, ten or twelve lines in length, was united in a similar manner by eight points of suture. The intestine was then replaced in the abdominal cavity, the ends of the threads being retained on the outside. The patient died in thirty-eight hours in consequence of effusion into the peritoneal cavity from other penetrating wounds of the intestinal tube. The sutures in the wounds of the bowel were covered by a layer of lymph, without any appearance of pus. No thread was visible on the interior; nor was there any interval between the edges of the solutions of continuity. The longitudinal wound formed a projection of two lines in height. The lips of the division still remained in contact even after the removal of the threads; on dragging them apart it was found that they had been united by plastic lymph.

CASE II.—Irreducible scrotal hernia—rupture of the bowel by a blow—opening closed by two points of suture—death in less than twenty-four hours.

In this case, the patient, who had been affected with a large irreducible scrotal hernia, received a violent blow on the swelling, followed by symptoms indicating injury of the intestinal canal. On opening the tumor a wound of the bowel was discovered, which was united in the same manner as in the former case, by two points of suture. Death ensued in the night after the operation. The edges of the intestinal wound were found united by plastic lymph, as in the preceding instance.

CASE III.—Two gunshot wounds eight inches from each other—excision of the whole of the injured part—ligation of the mesentery—number of sutures not mentioned—death on the third day from faecal effusion caused by an opening in the cæcum.

* Finally, a third unsuccessful case is recorded by Mons. M. L. Baudens, in the work already quoted.* A soldier of the thirteenth regiment of the line was struck by a ball which entered a little to the right of the umbilical region, and passed out behind in the corresponding loin. On introducing the fore-finger into the anterior opening, which was a little larger than usual, the surgeon came in contact with two flattened balls, which had been forced from the man's watch-fob into the abdomen at the moment of the accident. Having extracted these foreign bodies, he conveyed the finger down to the surface of the bowel, which, from its hard and contracted state, he at once supposed to be injured. The affected portion of the tube was then withdrawn, and the simple slit-like aperture which it presented closed with three points of suture. He was about to return the protruded bowel, when, by some exertion of the patient, a fresh portion descended, which was found to have been completely perforated by the ball, eight

* Clinique des Plaies D'Armes et Feu, p. 333.

inches from the seat of the other injury. Believing that the best plan would be to remove the whole of the affected part, he accordingly excised it, having previously included the mesentery in a ligature, to prevent hemorrhage. The edges of the new wound were then brought into contact, and retained by Lembert's process; the intestine was reduced, and the ligature just alluded to left hanging out at the external opening. Death occurred on the third day. The sutures were covered with a considerable quantity of plastic lymph, which was already organized; strong adhesions existed between the injured parts and the rest of the small bowel; the perforated omentum had formed extensive attachments; and some coagulated blood was detected between the intestinal convolutions. In prosecuting the dissection, Mons. Baudens discovered an opening in the cæcum with an effusion of fæces, which had been already bounded by the adhesive process; the peritoneum, at this part, was red and very much inflamed, and this at once accounted for the fatal termination of the case.

The late Baron Dupuytren proposed, a few years ago, a modification of Mons. Lembert's method, consisting mainly in the use of the continued instead of the interrupted suture, as recommended by the latter surgeon. The principal advantages attributed to it are, that it is more simple, and that it insures more accurate apposition of the edges of the wound, thereby lessening somewhat the risk of stercoraceous effusion.*

To execute this suture, as modified by Dupuytren, the surgeon takes hold of one end of the bowel with the left thumb and fore-finger, the latter being within the tube, and carries a needle through its tunics a line and a half from the wound, and as near as possible to the mesentery. Leaving a length of thread of about five inches, he intrusts this to an assistant, while he himself grasps the other end, which he treats precisely in the same manner. Having made these two preliminary points, the

* *Traité Theorique et Pratique des Blessures Par Armes de Guerre, rédigé par Paillard et Marx, T. i, 186. Paris, 1834.*

needle is conveyed alternately from one side of the breach to the other, as in the glover's suture, until the entire track is sewed up. The thread being cut off at the same distance from the bowel as at the other angle of the wound, the different stitches are adjusted with a pair of forceps and rendered equally tense throughout. The parts are now returned into the abdomen, and the ends of the ligature brought out at the external incision, where they are to be left for five or six days until the adhesive process is sufficiently advanced, when they may be gently pulled to encourage their separation. If this should be attended with much difficulty, the protruding extremities may be cut off on a level with the skin, and the remainder left to make its way into the interior of the canal. Or, the ends may be cut off in the first instance, and a thread tied to the central loop of the suture before the bowel is restored to the abdomen. By pulling this, when the proper period has arrived, the suture may be easily withdrawn.

The original method of Lembert may be further illustrated by the following experiments. They amount altogether to twenty-three in number, and were performed with great care. It will be seen that all, excepting four, had a favorable termination, notwithstanding that the wounds in some of them were of unusual extent. In three, death was produced by peritoneal inflammation, from the escape of fæcal matter; in the other, the animal perished without any obvious or assignable cause. In three of the cases the wound was transverse, in the other longitudinal. In the latter—Experiment II—it was three inches and a half in length, and closed by eleven sutures; death occurred on the thirteenth day from the extravasation of fæcal matter, occasioned by the imperfect union of the edges of the incision at its upper angle. All the sutures, except two, had disappeared, the wound was scarcely more than two inches long, and the reparation had been effected mainly through the intervention of an adjacent fold of the small intestine. The caliber of the tube was of the natural size in nearly all the cases in which the parts were examined after death. In a considerable number of them the consolidation of the lips

of the wound was remarkably perfect, even at a very early period after the experiment, much more so, indeed, than after the use of the continued or interrupted suture.

a.—*Transverse Wounds.*

EXPERIMENT I.—Complete section of the ileum—four sutures—death in thirty-seven hours from peritoneal inflammation.

June 17, 1842, in the presence of Dr. McDowell, Professor Miller, Dr. Hagan, and Dr. Colescott, I opened the abdomen of a middle-sized and full-grown dog, and exposed a fold of the small bowel, two feet from the ileo-cæcal valve, which was divided entirely across, and the wound closed with four sutures, equidistant from each other. The animal bore the operation well, but he soon sickened, and died in thirty-seven hours from the time he was removed from the table. The outer wound was feebly united by lymph, and free from omentum. The abdominal cavity contained six ounces of reddish serosity, and the peritoneum, both visceral and parietal, was extensively inflamed. The bowels adhered to the omentum and to each other at various points, and in several of the interstices between them was a small quantity of mucous and fæculent matter. The sutures retained their original situation, and their surface was only partially coated with lymph. On each side of the mesentery the edges of the wound were everted, with a corresponding opening, scarcely two lines in length, through which the alvine fluid had escaped.

EXPERIMENT II.—Complete division of the small intestine—six sutures—the animal killed at the end of the ninth day.

Assisted by the gentlemen who witnessed the preceding experiment, I made a transverse section of the small bowel, and retained the divided edges by means of six sutures, placed at equal distances from each other. The animal, an old slut, bore the operation without much resistance,

and suffered apparently very little afterwards. At the end of the ninth day, the cure being considered as established, she was killed. The external wound, which presented nothing unusual, contained a process of omentum: there was no adhesion of the injured part to the adjacent folds of the gut or to the wall of the abdomen, but it was united very firmly to the epiploon, which thus served to point out its situation. The peritoneum was free from inflammation, and the same was the case with the mucous membrane, even in the immediate vicinity of the lesion.

EXPERIMENT III.—Complete section of the small bowel—six sutures—fæcal effusion—death from peritoneal inflammation.

The subject of this experiment was a young dog of middle size, in which the bowel, cut entirely across, was sewed up with six sutures, as nearly as possible equidistant from each other. The operation, which was borne well, was performed on the 14th of July, and death occurred on the seventeenth, or about three days and a half after; the animal having all along refused food, and also, during the last forty hours, drink. On examination I discovered about five ounces of thin, dirty-colored fluid, evidently of a fæculent nature, with high marks of peritoneal inflammation. Very little adhesion existed between the bowels, except at the seat of the wound, the edges of which were widely separated from each other, all the sutures, save one, having lost their connexion. Small gangrenous patches were seen in different parts of the ileum, and the mucous membrane was deeply inflamed at several points. The external wound was firmly united.

EXPERIMENT IV.—Entire division of the small intestine—six sutures—fæcal effusion—death from peritoneal inflammation.

From a small but stout and full-grown dog, I removed a knuckle of the ileum, which was cut completely across, about two feet from the ileo-cæcal valve. The edges were brought

together, and maintained in apposition by six sutures, equidistant from each other. The dog struggled a good deal during the operation, from the effects of which, however, he speedily recovered, taking food and drink as usual. At the end of the seventeenth day, being in good plight, and the cure fully established, he was killed. The following appearances were observed on dissection.

The abdominal wound was completely healed, a process of omentum being, as usual, prolonged into it. The injured bowel adhered to a neighboring fold for about three inches, through the medium of a smooth and polished texture resembling serous membrane. A small process of the epiploon was united to the outer surface of the wound, and exhibited a dark modena appearance, from the effusion, probably, of blood at the time of the operation. The omentum was spread over the whole surface of the bowels, which were entirely free from adhesions, except at the place before alluded to. Their movements must therefore have been altogether unimpeded. Internally, the reparation was perfect. The sutures had all disappeared, and the villous edges were not only in apposition with each other, but continuous throughout their entire extent. In fact, the cicatrization could not have been more beautiful or complete. The caliber of the tube at the seat of the lesion was of the natural size.

EXPERIMENT V.—Complete division of the upper part of the small bowel—six sutures—the animal killed at the end of the sixteenth day.

The dog employed in this experiment was small but full-grown, and had fasted twenty-four hours. The bowel was divided within fifteen inches of the pyloric extremity of the stomach, and the wound closed by six sutures. No untoward symptoms followed the operation, which was borne without any unusual resistance. He was killed at the end of the sixteenth day, being apparently well but somewhat emaciated. The intestines were every where free from morbid attachments. The omentum adhered around the inner wound,

and projected into the outer, precisely as in the preceding experiment. Half of the villous portion of the breach was completely repaired, the remainder only imperfectly, three of the sutures being still retained, and the lips, although in contact, not firmly united with each other. The mucous membrane was of a pale rose color, but not inflamed, and the caliber of the tube natural.

EXPERIMENT VI.—Transverse wound six lines in extent—three sutures—the animal killed at the end of a fortnight.

A transverse incision, six lines in length, was made into the lower portion of the ileum, and closed by three points of suture. The dog, a small young tarrier, was scarcely affected by the operation, took food as usual, and was quite playful. At the end of a fortnight he was killed.

A plug of omentum was prolonged into the outer wound, which was nearly cicatrized. The injured bowel adhered to the mesentery and to a neighboring knuckle, by a small quantity of firm, organized lymph, partially transformed into serous texture. Internally, the wound was beautifully repaired, the villous edges being every where in contact, and in the greater part of their extent inseparably connected with each other. One suture, however, still remained, with well-marked traces of the other two. The tube was fully as capacious at the seat of the injury as elsewhere.

EXPERIMENT VII.—Transverse section of the small bowel—four sutures—recovery.

In this experiment the small intestine was divided entirely across, and the wound closed by four sutures, which had the effect of completely inverting the serous surfaces, as the tube was unusually narrow. The animal, a small slut, soon recovered from the shock of the operation, and escaped from her box on the seventh day, in good health. She was seen in the street more than a fortnight after; at a period, consequently, when it may be supposed she had entirely recovered.

EXPERIMENT VIII.—Complete division of the small bowel—four sutures—death in forty-four hours without any assignable cause.

Having drawn out a fold of the ileum and cut it completely across, I approximated the edges of the wound with the same number of sutures as in the preceding experiment. These had the effect of closing the breach in its entire extent, and of bringing the serous surfaces beautifully together. The dog seemed pretty comfortable for the first six or eight hours, when he began to evince signs of severe suffering, in which he died forty-four hours after he was removed from the table. No attempt at re-union was visible in the outer wound. The edges of the inner wound remained inverted, except at one of its mesenteric angles, where they were slightly separated; scarcely any lymph was discoverable upon them, and the sutures were as distinct and as perfectly in their places as at the moment of their introduction. The peritoneum in the vicinity of the injury was slightly inflamed, but there was no adhesion of the intestines to each other or to the walls of the abdomen. On laying open the tube, the inverted edges were found to form a small valve-like prominence, which was not sufficient, however, to produce any obstruction. What was the cause of death remains therefore a mystery. The probability is that the animal died from the shock of the operation.

EXPERIMENT IX.—Complete section of the ileum—six sutures—the animal killed at the end of the twenty-second day.

The subject of this experiment was a large healthy dog that had fasted for twenty-four hours. The small bowel was cut completely across within a foot of the ileo-cæcal valve, and the divided parts were approximated by means of six sutures, equidistant from each other. The dog made some resistance during the operation, and appeared to be considerably exhausted by it. Nevertheless, he rapidly recovered, and was permitted to live till the end of the twenty-second day, when he was killed.

The outer wound was completely healed, and projecting into it was a slender process of omentum. There was no adhesion between the bowels, or between these and the surrounding parts, except at the wound, the surface of which was covered by a mass of epiploon. The tube, which was of the natural size, presented two small sacs or pouches, one above and the other below the seat of the breach, which was perfectly cicatrized, the villous margins being every where continuous with each other. The mucous membrane had a healthy appearance; and the animal, notwithstanding his long confinement and irregular feeding, was in good order.

EXPERIMENT X.—Two transverse wounds each half an inch in length—one closed with two, the other with three sutures—the animal killed at the end of the twenty-second day.

From a small dog that had fasted nearly a day, I removed a loop of the small intestine, and made two transverse incisions into it, each six lines long, the first four, the other seven inches from the cœcum. One of these I closed with two, the other with three sutures. The animal bore the operation without flinching, and lived, without any untoward occurrence, until the end of the twenty-second day, when he was killed. The abdominal wound exhibited the usual appearances, that is, it was perfectly cicatrized through the intervention of a plug of omentum. The bowels were free from adhesions, except at the seats of the injury, to each of which was attached a small process of the epiploon. One suture remained in each wound, but it was evident that their presence had not been productive of any mischief, as the continuity of the villous edges had been perfectly re-established. Indeed, the union could not have been more satisfactory. The diameter of the tube was natural.

b.—*Longitudinal Wounds.*

EXPERIMENT I.—Longitudinal wound two inches in length—seven interrupted sutures—the animal killed on the twenty-fourth day.

This experiment, together with some of the succeeding ones, was witnessed by Professor Miller and Dr. McDowell. It consisted in making a longitudinal incision, two inches in length, along the convex surface of the small bowel of a middle-sized slut, and in bringing the edges together with seven sutures at equal distances from each other. The animal suffered a good deal for the first twenty-four hours, after which she became comfortable, and so continued until the twenty-fourth day, when, being in good condition, she was killed. The external wound was perfectly cicatrized, and contained no epiploon. The small bowels were matted together, as well as to the omentum, by dense, organized lymph, but they did not adhere to the wall of the abdomen, nor was there any unnatural redness of the peritoneal surface, except at the seat of the injury, where a small ecchymotic spot was visible. On laying open the wounded intestine, the breach was found to be perfectly and beautifully cicatrized in its entire extent, save a small point at each extremity, where the union was not so complete. At one of these places was a small abscess containing a few drops of pus and two ligatures, one partially, the other wholly detached. The injured part adhered firmly to a neighboring fold of the gut, and was in no wise contracted or diminished in its caliber. The adhesion of the villous edges of the wound was more perfect, excepting at the extremities just mentioned, than I ever saw it before in so short a time.

EXPERIMENT II.—Longitudinal wound three inches and a half long—eleven sutures—death on the thirteenth day from fæcal effusion.

This experiment was performed immediately after the last, and with the assistance of the same gentlemen. The wound, extending for three inches and a half along the convex surface of the small bowel, was closed by eleven sutures, as nearly as possible equidistant from each other. The animal was exceedingly fractious, and was much exhausted by the operation, in other respects already sufficiently tedious. For the first few days he was drowsy and listless, refusing such food as was offered him. Before the expiration, however, of the middle of the first week he became more gay, and in a short time appeared to be quite well. He remained thus until the twelfth day, when he was taken sick, and on the thirteenth he expired.

The small bowels were extensively united to each other and to the omentum, a process of which projected into the outer wound. The inner wound had contracted to two inches, and all the sutures, except two, had disappeared. The edges were nearly four lines apart at their centre, elevated, and rounded off, the bottom of the breach, formed by an adjacent fold of the intestine, being covered by a layer of tough, organized lymph. This had given way at the upper extremity of the wound, producing a circular aperture, nearly as large as a five cent piece, through which upwards of eight ounces of thin, fluid, alvine matter had escaped into the peritoneal cavity, where it induced fatal inflammation. The lymph which connected the convolutions of the bowel was firm, dense, and partially transformed into serous texture. The dog was in good condition, and considered out of danger until the occurrence of the accident which carried him off.

EXPERIMENT III.—Longitudinal wound one inch and a half long—four sutures—recovery.

From a full-grown tarrier a fold of the small bowel was

drawn, and an incision, an inch and a half long, made upon its convex surface, directly opposite the mesentery. The edges of the wound were brought together by four sutures, which had the effect of preventing any protrusion of the villous membrane. The dog suffered apparently no inconvenience from the operation, taking food and drink as before. A month after, the cure being considered as fully established, he was set at liberty.

EXPERIMENT IV.—Longitudinal wound half an inch long—two sutures—the animal killed on the seventeenth day.

A small pup, not more than about four months old, formed the subject of this experiment. The wound, only six lines long, was made along the convex surface of the intestine, as in the preceding experiment, and closed by two sutures. The animal was a good deal indisposed for the first forty-eight hours, but he gradually recovered his health and appetite, and lived until the seventeenth day, when I had him killed. The external opening was perfectly healed with the intervention of a narrow strip of omentum. The small intestines were slightly adherent to each other, and the internal wound was beautifully cicatrized. Both sutures had disappeared, and the villous portion of the breach was perfectly repaired. No contraction of the injured part was discoverable.

EXPERIMENT V.—Longitudinal wound three-quarters of an inch in length—three sutures—the animal killed at the end of the tenth day.

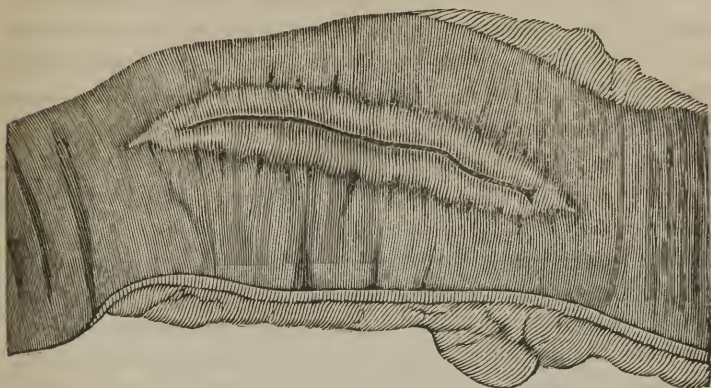
The subject of this experiment was a small dog, probably two or three years of age, into the ileum of which, about its middle, I made a longitudinal wound three-fourths of an inch in extent, and brought the edges together by three sutures at equal intervals. The animal bore the operation well, and soon recovered his wonted energy and spirits. He was killed at the end of the tenth day, the cure being considered as established.

The abdominal wound was nearly healed, with a process of epiploon interposed between its inner lips. A small fold of this apron-like membrane was also united to the outer surface of the intestinal wound, and the affected bowel had contracted pretty extensive adhesions to several of the adjacent convolutions. On laying open the tube the villous edges were found to be in close contact with each other, with only a partial re-establishment, however, of their continuity. The sutures still retained their hold, and were buried, as it were, in the substance of the mucous membrane. The latter was perfectly healthy both above and below the seat of the lesion, and the canal itself was in no respect diminished.

EXPERIMENT VI.—Longitudinal wound two inches and a half in length—eight sutures—the animal killed at the end of the seventeenth day.

From a very large and healthy dog, shortly after he had eaten a hearty meal, I removed a fold of the upper portion of the jejunum, and made a longitudinal incision, two inches in extent, along its convex surface, directly opposite the mesentery. The edges of the wound were approximated with eight sutures, equidistant from each other. The animal was exceedingly restive during the operation, which was in consequence somewhat protracted, and he lost several ounces of blood. For the first few hours he appeared languid and exhausted, but he rapidly recovered, and was killed at the end of the seventeenth day, being at the time in good condition. The outer wound was perfectly healed with a plug of epiploon between its inner edges. The bowels were free from adhesions, except at the seat of the injury, the surface of which was covered by a small slip of omentum. The caliber of the tube was of the normal size, and the reparation complete. The villous margins of the wound were, however, a good deal more elevated than common; but it was evident that they were every where continuous with each other. The marks of the sutures were still visible. The wound had diminished in length about half an inch.

The mucous coat was perfectly sound, and unpuckered. The arrangement of the parts is tolerably well seen in the draw-



ing. The dark line in the centre represents the ridge formed by the junction of the lips of the wound, which, as has just been stated, were firmly united through their entire extent

EXPERIMENT VII.—Longitudinal wound of the ileum three inches in length—twelve sutures—recovery—the animal killed at the end of the twentieth day.

The subject of this experiment was an old dog, of moderate size, which had fasted for twenty-four hours. The wound was three inches in length, and occupied the lower surface of the small gut, two feet from the ileo-cæcal valve. The sides of the solution of continuity were approximated by means of twelve sutures, placed equidistant from each other. The operation was tedious, and the dog was considerably exhausted before he was removed from the table. During the afternoon he was indisposed to move about, but the next morning the re-action seemed to be completely established, and from this time he rapidly convalesced. He was permitted to live until the expiration of the twentieth day.

On dissection the following appearances were observed. The abdominal wound was entirely cicatrized, and a thick

plug of the epiploon intervened between its inner margins. The injured bowel was firmly united to a process of the mesentery, to the omentum, and to the neighboring knuckles, by smooth and organized bands of lymph, strongly resembling the serous tissue. The peritoneal lips of the wound were scarcely discoverable; and as to the villous, they were not only in close contact but inseparably blended together. In fact, the restoration could not have been more perfect. The cicatrice, raised in the form of a narrow ridge, was not more than two inches and a quarter in length, the mucous membrane was no where puckered or diseased, and the tube retained its natural volume. All the sutures had disappeared, though the marks of some of them were still visible, and the villous edges were somewhat elevated, owing to interstitial deposits of plastic lymph. The animal was in good condition, having suffered little or no emaciation from his confinement.

EXPERIMENT VIII.—Two wounds, one longitudinal and the other transverse, the first one inch long, the second three-quarters of an inch—each opening closed with three sutures—recovery—the animal killed at the end of twenty-eight days.

Into the ileum of a small and very old dog I made two incisions, about eighteen inches from the ileo-cæcal valve. One of the wounds was longitudinal, twelve lines in extent, and situated upon the convex surface of the gut, five inches from the other, which was horizontal, and three lines shorter. Each opening was closed by means of three sutures, equidistant from each other. The dog had fasted for twelve or fifteen hours before the operation, from which he seemed to suffer severely. Notwithstanding this, he rapidly regained his health, and remaining well and in good order, he was killed on the twenty-eighth day.

The outer wound was perfectly healed, without the intervention of the omentum. The bowels had contracted firm and extensive adhesions to each other, as well as to the apron-like lamella just mentioned, but the lymph by which they were produced was quite smooth, organized, and in process

of absorption. The sutures had disappeared from both wounds, even to the most minute trace, and the edges of the latter, both serous and villous, were continuous with each other through the whole of their extent and beautifully united. The longitudinal breach was somewhat diminished in length, but the other retained its original size. In both, the cicatrice presented a smooth, rounded, and slightly elevated appearance. The mucous membrane was free from puckers, and the diameter of the tube natural.

EXPERIMENT IX.—Two wounds, each an inch in length—one opening closed with Lembert's, the other with the continued suture—recovery.

In the month of January last, in presence of the medical class, I removed a portion of the small intestine from the abdomen of a small fat dog, eighteen hours after he had taken food, and made two incisions along the convex surface of the tube each fully an inch in length. The lips of one of the wounds were approximated by three points of Lembert's, those of the other by the glover's suture; the contact in each being very close and intimate, so as to prevent the possibility of fæcal effusion. Having cleared away the coagulated blood, the parts were returned into the abdomen, and the edges of the outer wound retained by several points of the interrupted suture. The animal was kept on light diet for the first three or four days, with milk and water for his drink. No untoward symptoms occurring, and the cure being considered as fully established, he was set at liberty on the fifteenth day.

c.—Oblique Wounds.

EXPERIMENT I.—Oblique wound of the small bowel one inch and a half long—five sutures—the animal killed at the end of the twelfth day.

The subject of this experiment, a moderate-sized slut, apparently several years old, had fasted for twenty-four hours. The incision was two feet from the ileo-cæcal valve, and extended obliquely across the gut from one side of the mesen-

tery to within a few lines of the other for one inch and a half. Five sutures, equidistant from each other, were introduced, which had the effect, when tied, of accurately closing the opening in its entire length. No untoward symptoms supervened upon the operation, and the animal was killed at the end of the twelfth day, in good health and condition.

The outer wound was perfectly healed with a portion of omentum prolonged into it. The bowels were entirely free from adhesions, except at the seat of the lesion, which was covered with a small mass of adherent epiploon of a red color. The affected part of the tube was of the natural width, and contained a small quantity of mucous and fæculent fluid. The villous edges were not only in contact with each other but firmly consolidated, their continuity being thoroughly re-established, except at the upper extremity of the breach, where there was a depression about half a line in diameter.

EXPERIMENT II.—Oblique wound of the small bowel one inch and three-quarters long—six sutures—the animal killed at the end of the twelfth day.

This experiment was merely a repetition of the preceding. The animal, a small young slut, had fasted for twenty-four hours, and the wound, which was one inch and three-quarters long, extended obliquely from one side of the mesentery to the other. Six sutures were employed at equal intervals. In making the outer opening the bladder was accidentally punctured, followed by a free escape of urine, but no unpleasant symptoms afterwards. At the end of the twelfth day, the animal, being in good health, was killed.

The outer wound had healed through the intervention of a piece of the omentum, as in the preceding experiment. There was no adhesion of the intestines to each other, to the wall of the abdomen, to the other viscera, or to the epiploon, except at the seat of the injury. Two sutures remained in the wound, one being loose, the other slightly attached. The villous edges were separated from each other, without any apparent effort at re-union. The bowel, which retained its natural width, formed a sort of cul-de-sac just above

and below the wound, seemingly from the vicious attachment of the omentum. The villous membrane was healthy, and covered with thick, viscid mucus. All the other viscera were sound. The wound in the bladder was beautifully cicatrized.

EXPERIMENT III.—Oblique wound one inch long—four sutures—the animal killed at the end of the twenty-second day.

The animal which formed the subject of this experiment was very small and not more than nine or ten months old: he had fasted for twenty-four hours. The wound, an inch long, was situated one foot from the ileo-cæcal valve, and closed with four sutures. Speedy recovery ensued, or, rather the animal did not seem to be affected by the injury, and he was permitted to live till the end of the twenty-second day. The appearances revealed by the examination so nearly resembled those in the last two experiments that it is scarcely necessary to specify them. The outer opening had, as usual, a process of omentum in it, and a small process was also attached to the intestinal wound, which was beautifully cicatrized, the continuity of the villous surfaces being completely re-established. It had diminished about one-fourth in length. The diameter of the tube, however, was natural. The dog was in good order.

EXPERIMENT IV.—Oblique wound of the ileum two inches long—six sutures—recovery—the animal killed at the end of the thirteenth day.

The dog was old and of middle size, and made much resistance during the operation, which was consequently somewhat tedious. The experiment was witnessed by Dr. Dodson, Dr. Richard Ferguson, and several other medical friends. The incision, extending obliquely from one side of the mesentery to the other, was two inches in length, and closed by six points of suture equidistant from each other. The dog soon recovered from the effects of the operation, and was allowed to live until the expiration of the thirteenth day.

The outer wound presented nothing unusual. It was pretty firmly cicatrized, with a process of omentum projecting between its inner lips. The injured bowel, intimately connected to several neighboring coils by plastic lymph, was distended with semi-fluid fæcal matter. All the sutures, except two, had escaped; the villous edges of the wound were beautifully united throughout their entire extent, and had an elevated, tumefied appearance; there was no puckering of the mucous membrane, and the cicatrice was less distinctly marked than in some of the other cases. The tube retained its natural dimensions. It should have been stated that the wound had diminished in length fully half an inch.

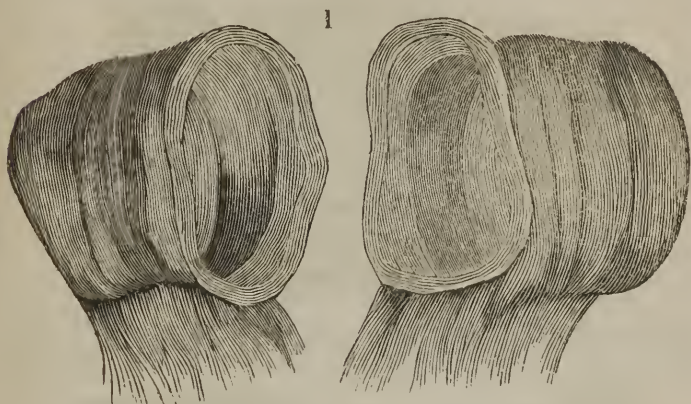
10.—*Method of Denans.*

In 1826, Mons. Denans, a surgeon of Marseilles, proposed the employment of three hollow metallic cylinders, in the belief that the serous surfaces of the divided ends of the gut could thereby be kept more effectually in contact than by any other proceeding.* One cylinder is placed into each extremity of the tube, which is then invaginated; the other cylinder, namely, the third, a little narrower than the rest, is next introduced, first into the upper and then into the lower, so as to confine and compress the inverted edges, and serve as a sort of rod for their support. Two of the cylinders are each three lines long, and the other or intermediate one six lines; and each end of the gut is inverted about two lines. To fasten these cylinders Denans employs several points of suture, which embrace the lips of the wound and assist in maintaining them in accurate apposition. When the operation is completed the ends of the threads are cut off close to the peritoneal surface, and the parts returned into the abdomen. The agglutination of the approximated structures is soon effected, and the inverted extremities of the bowel, deprived of their vitality by the pressure of the apparatus, rap-

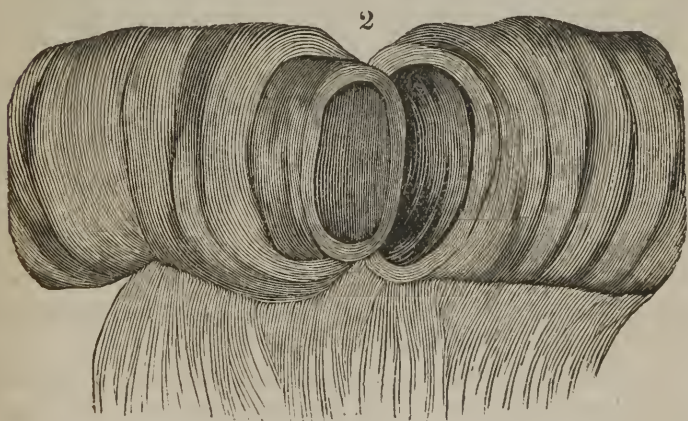
* Recueil de la Société de Médecine de Marseille, No. 1. 1826

idly slough off. The metallic ferules, thus set free, are discharged along with the fæces.

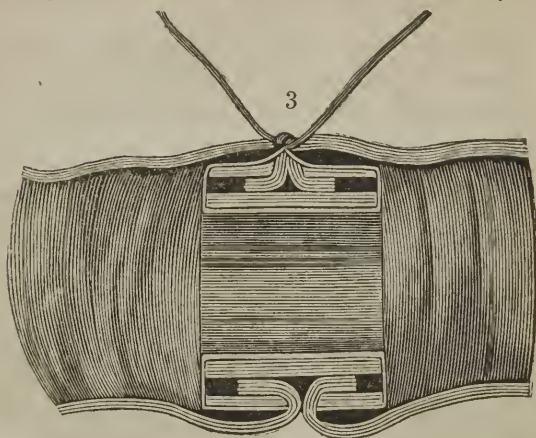
The accompanying engravings will more fully explain the nature of Denans' apparatus and the manner of securing it in the intestinal tube. Figure 1 shows the approximation



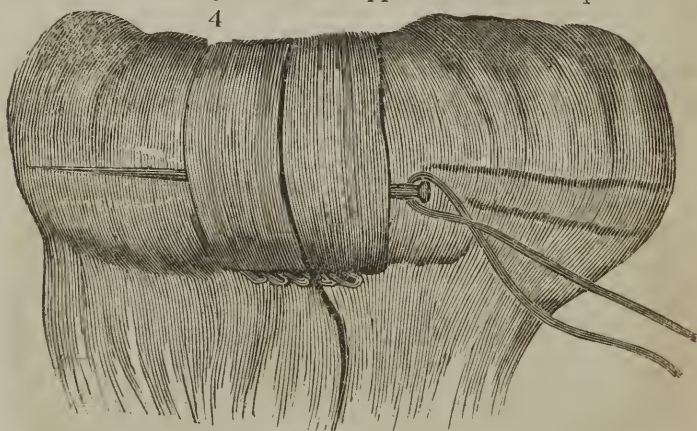
of the two ends of the bowel, with the small cylinders in their interior; figure 2, the situation of the middle or long



ferule; figure 3, a vertical section of the bowel, and the pas-



sage of one of the ligatures, to maintain the apposition of the serous surfaces; figure 4, the appearance of the parts after



they have been brought together, and the manner of introducing the suture in this stage of the operation.

It is said that this mode of treatment furnished only one successful case in four. In a memoir presented to the Royal Academy of Medicine of Paris, Denans states that in the first experiment the ferules did not pass out of the bowels until seventeen days after the operation. In the second case he

wrapped up a small bone in a piece of bread, which was given to the dog, and the instruments were voided at the end of eight days.*

Denans, having recently simplified the above method, now restricts himself exclusively to the three ferules, which are so closely fitted into each other as to obviate the necessity of the suture. The new process is thus described by Dr. Charles Phillips of Liege.† There is, first, a circular row of springs similar to those used as clasps for ladies bracelets. Secondly, the outer ferules are of a conical form, the base of each having a border a line in extent, which, although covered by the reflected intestine, still holds the springs of the inner ring which pass beyond it. By this arrangement the practitioner escapes the difficulty experienced in using the suture. When the first spring is once adjusted, it is only necessary to reflect as much of the bowel as is considered requisite; an advantage which prevents the tumefaction of the edges of the wound and the formation of a fold at the inside of the ferules, which, it is alledged, was the constant cause of the want of success of the original method.

Without having apparently any knowledge of the process of Denans, above described, a very similar practice was proposed, a few years ago, by Mons. Baudens, of France. His account of it is to be found in his work on Gun-shot Wounds, published in 1836. It is certainly less complicated than that of his countryman, but whether it will ultimately be found to possess any decided advantages over it is a circumstance which it is impossible to predict. Baudens uses only one metallic ferule with a ring of gum-elastic, instead of three, as is in the process of Denans. The ferule, moreover, differs from that of Denans in being concave on the back, where it is formed into a groove to adapt it to the gum-elastic ring which embraces it like a clasp. The following is the manner in which the apparatus is applied.

* London Lancet for 1834-'5, p. 202.

† Ibid, p. 202.

The elastic ring is introduced a quarter of an inch within the upper end, the lips of which are immediately inverted, and consequently folded over the instrument, which thus lies in the angle formed by the gut. The serule is next engaged in the lower end, to the extent of two lines, when the ring is drawn down over it, and the bowel is ready to be reduced into its natural situation. Baudens states that he has employed this method successfully on dogs, and that he would not hesitate, if occasion offered, to resort to it in the human subject.

A distinguished writer in the *Dictionnaire de Médecine et de Chirurgie Pratiques*, Mons. L. J. Sanson, in summing up the advantages of the different methods of treatment of wounds of the intestinal canal, gives a decided preference to that of Denans. He seems to think that it will insure more perfect apposition of the divided ends, and that it is better calculated also to prevent contraction of the affected bowel, so apt to follow, as he supposes, some of the other procedures. He does not, however, support his arguments by any experiments or observations, and they should therefore be received for what they are worth—merely as so many closet speculations. Mr. Lawrence,* in speaking of this method, very justly remarks that “a patient who could survive the infliction of such surgery must be endowed with great tenacity of life.”

II.—*Method of Reybard.*

The next method that claims our attention is that of Mons. Reybard, of Paris, an account of which was published in 1837, in his “*Memoir on Artificial Anus.*”† The object of it, as set forth by the author, is to effect a temporary obliteration of the wound and to maintain the bowel in strict relation with the wall of the abdomen. For this purpose a ligature, armed with two sewing needles, is passed through a light wooden cylinder, perfectly smooth on its ex-

* Treatise on Ruptures, p. 356.

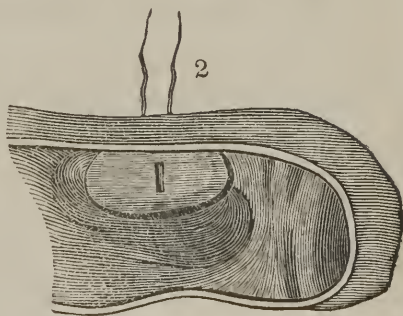
† See Vidal, *Traité de Pathologie Externe*, T. 4, p. 503.—Velpéau, *Medicine Operatoire*, T. 4, p. 135.

terior, and from fifteen to sixteen lines in length by eight or nine in diameter. Thus arranged, and having previously, like Ramdohr, detached a small piece of the mesentery along the concave surface of the tube, the cylinder is introduced into the intestines, where it is fastened by carrying the needles from within outwards through the lips of the wound, about a quarter of an inch from its margin. The extremities of the ligature, crossed and twisted together, are passed, by means of a crooked needle, through the abdominal muscles, at a short distance from the edge of the outer opening. The double thread is now held by an assistant until the surgeon has reduced the bowel; when, taking it in his left hand, he pulls it, and satisfies himself that the injured part is in exact apposition with the abdominal parietes. The operation is completed by separating the ligatures, and tying them over a small compress lying parallel with the inner lip of the wound. In an experiment performed after this method the sutures were cut away at the end of forty-eight hours, and the following morning the wooden cylinder was expelled along with the fæces.*

The nature of this operation will be more fully understood by a reference to the engravings. Figure 1 represents the wooden cylinder.



Figure 2 is a longitudinal section of the bowel with the cylinder fastened by the ligature.



* Vidal, op. cit. T. 4, p. 503.

Fig. 3 shows the appearance of the parts ready to be returned into the abdominal cavity.



Not having repeated the experiment of Reybard, I cannot speak of it from personal observation. It appears to me, however, to be entirely too complicated, to say nothing of the danger which must necessarily arise from the presence of a foreign body, such as he suggests, and which, it may be supposed, might easily be retained in the alimentary canal, causing severe, if not fatal, inflammation, ulcerative absorption, or insurmountable obstruction to the passage of the fæces. It has, moreover, I believe, never been employed in the human subject, and it is obviously nothing but a modification of the process of Duverger, Sabatier, and other surgeons, who recommend the use of a piece of trachea, or other hollow body. Such a proceeding is entirely too mechanical, and would have been better suited to the dark ages than it is to the nineteenth century.

12.—*Method of Amussat, Thomson, Choisy and Beclard.*

As if there were no end to the devices of surgeons for the cure of wounds of the intestines, Professor Amussat, of Paris, has recently proposed another, apparently highly ingenious, which deserves to be mentioned here more on account of its novelty than from any probability that it will ever be employed in the human subject. Like that of Lembert, Denans and Jobert, its object is to place the two serous surfaces in contact with each other, to facilitate the adhesive process, and prevent the effusion of stercoraceous matter. The idea originally suggested itself

to Amussat from observing, on repeating the celebrated experiment of Mr. Travers of encircling the bowel with a ligature, with what rapidity the continuity of the tube is re-established at the seat of the constriction, and how little the operation interferes with the comfort of the animal, or the transmission of the fæces. The apparatus which he was led to employ in the first instance was simply a piece of elder-tube, half an inch long, with a narrow central groove, and a diameter somewhat less than that of the intestine. This being introduced into the divided ends of the gut, with the precaution of making the lower overlap the other, as in the operation of Chopart and Desault, a ligature was applied around the parts corresponding with the groove, and drawn with sufficient tightness to cause their strangulation. The result, however, was unsuccessful. The adhesions, from the imperfect approximation of the serous surfaces, failed to acquire the proper degree of solidity, and hence, when the constricted parts were detached, the edges of the wound separated from each other, and the animal promptly perished from the effects of fæcal effusion.

To obviate this accident, Amussat applied to each end of the elder-tube a small conical ferule, which he fastened by means of a small strip of adhesive plaster, the base of the one being turned towards that of the other. By this arrangement he obtained a deep groove, instead of a superficial depression, as in the other contrivance. Two ligatures, six inches long, each passed through a straight needle, and placed opposite each other on the edge at the truncated top of one of the ferules, complete the apparatus by which the strangulation is effected. Thus arranged, the operator introduces the elder-tube into one of the ends of the bowel, where it is secured by passing the needles from within outward through its tunics. The other extremity, held open with several forceps, is then transfixes with both needles together in the same direction, an inch from the lip of the wound, when by means of the two threads the intestine is gradually drawn over the remainder of the foreign body, or, rather, high enough to overlap

the other portion to the extent of a few lines. A waxed cord is now applied around the central groove of the apparatus, and drawn with sufficient firmness to strangulate the parts which it embraces. Any redundant substance beyond the cord is to be removed with the scissors, otherwise it will interfere with the union of the serous surfaces, the grand object of the operation. In a few days the constricted parts slough, and the apparatus, being thus set free, is expelled along with the fæces.

Dr. Charles Phillips, to whom I am mainly indebted for this account of the above method, states that it will prove successful in four cases out of five, when performed with proper precaution. I have not deemed it necessary to repeat it on any of the inferior animals, from a conviction that it is obnoxious to the same objections as the process of Denans, without any compensating advantages. Like the operation of Ramdohr, of which, after all, it is merely a modification, it requires a previous separation of the mesentery, to facilitate the invagination of the upper into the lower end; to say nothing of the complicated nature of the apparatus, which cannot always be obtained on the spur of the moment, and which few practitioners will keep on hand in expectation of such an occurrence.

Soon after the above method was made public, Dr. Alexander Thomson, of Paris, suggested certain modifications in the construction of the apparatus, which, however, have only been employed, I believe, on the dead subject. It is impossible, therefore, to say how they might answer in the living. The tube, as improved by Thomson, consists of two pieces, instead of one, which are joined together by an ebony ring, a third of an inch long. The base of each tube is hollow, and marked by a groove two lines in depth by one and a half in width. When united, they present a ridge of two or three lines. "The moveable cone is pierced with two holes at its border for allowing the introduction of two ligatures. Two other waxed threads pass through the substance of the tube, upon which the other cone is fixed. The end of the groove

formed by the union of the two cones is made somewhat rough, for the purpose of keeping a more firm hold upon the intestine. The moveable cone is fixed upon a handle, which extends about three quarters of an inch beyond its truncated extremity. At the middle of the handle is a small permanent stud, for the purpose of holding the ligatures which are coiled around it. The extremity of the handle serves to open a free passage into the intestine, until it has reached two-thirds of an inch beyond the base of the cone fixed upon the said handle. Close to the stud are two steel arms, furnished with hooks and springs for securing the intestine. A ligature is then placed over the groove in the base of the cone, and tightened so as to produce strangulation of the intestine, the operator cutting off a portion of the extremity beyond the constricted part. The two ligatures are then loosened, by which the cone is set at liberty, a needle is put on each, and they are passed through the strangulated portion of intestine. The same method having been adopted with respect to the other end of the intestine, the two cones are then united in such a way that the ligatures applied for fixing them may be in immediate contact. They are tied, and cut off near the knots, and the intestine is returned into the abdomen.”*

Another modification of Amussat's method was proposed by Mons. Choisy, in a thesis which he presented to the Faculty of Paris, in 1837, for the degree of doctor of medicine. It consists simply in invaginating the divided bowel, and tying it over a piece of trachea. In performing the operation the foreign body is introduced into the superior extremity, where it is fastened by the glover's suture, after which the thread is carried from within outwards across the inferior end, the latter being thus made to cover a portion of the former. The ligature is then applied around the parts, as in Amussat's process, and drawn sufficiently tight to effect their strangulation.† Choisy has performed this operation several times

* London Lancet for 1835, p. 204.

† Velpeau, *Médecine Opératoire*, T. iv, p. 139.

successfully upon dogs, but whether it has been repeated by other surgeons I have not been able to learn.

Beclard, author of the "Elements of General Anatomy," suggested, many years ago, a mode of treating wounds of the intestinal canal, which, from the success that attended it in some of the inferior animals, he thought might be advantageously applied to the human subject.* It is certainly much more simple than that of Amussat, or the modifications of it by Thomson and Choisy, and if I could be induced to employ any process of the kind, I should unhesitatingly give it the preference. The method under consideration consists in introducing one end within the other, without the intervention of any foreign body, and in encircling them with a ligature drawn with moderate firmness. The serous surfaces are thus brought into close apposition with each other, and the cord, cutting its way through the coats of the intestine, falls in a few days into the tube, where it is discharged along with the fæces.

Such is an accurate and impartial account of the various and diversified methods of treatment of wounds of the intestinal canal. Of the estimate to be placed upon them, I have already expressed my opinion, excepting in a few instances, where the facts I have presented are competent to speak for themselves. My conviction is that there are but two sutures which should ever be thought of in the management of this class of injuries, namely, the continued and the interrupted, with the modification of the latter proposed by Lembert. The manner of executing them has been already explained, and it is not necessary, therefore, to say any thing further on the subject in this place.

Whichever of these sutures be employed, the operator should

* Chélius, *Traité de Chirurgie*, T. i, p. 176. Paris, 1835.

never lose sight of the important principle of closing the opening in the bowel in such a manner as to prevent the escape of fæcal matter. By guarding against this occurrence, the patient will run comparatively little risk of perishing from peritoneal inflammation. When the wound is transverse, and involves the whole cylinder of the tube, I should prefer the continued or common interrupted suture to the method of Lembert, especially in young subjects, in whom the canal is very narrow, or in persons in whom the bowel is over-loaded with fæcal matter at the moment of the injury. In a case of this kind the inverted edges might occasion serious obstruction, from the manner in which they project into the interior of the canal. To longitudinal and oblique wounds, particularly the former, the expedient of Lembert is admirably adapted. The operation is very simple, the sutures easily retain their hold, and the divided edges are more speedily re-united than by any other method.

In reflecting upon the results of the experiments which have been offered in illustration of the use of the above sutures, it should not be forgotten that an operation which is perfectly successful upon an inferior animal, may, when performed upon the human subject, be followed by the worst consequences. In the one, disease is exceedingly rare; in the other, it is not only frequent, but capable of assuming a vast variety of forms, and of sapping the foundations of life when least expected. In the one, peritoneal inflammation is not only uncommon, but, when developed, seldom attains any considerable height; in the other, it is not only easily excited, but extremely apt to terminate fatally. Aware of these facts, the surgeon should always scrupulously guard against the infliction of unnecessary injury; the stitching should be done as gently as possible; and all rough manipulation should be carefully avoided. After the parts have been reduced the external wound should be closed by several points of suture, and every effort made to avert peritoneal inflammation, the great source of danger in injuries of this kind.

It has been alleged that longitudinal do not unite with the

same facility as transverse wounds. "There is a curious difference," observes Sir A. Cooper,* "in the facility with which a longitudinal and a transverse wound of the intestine unite. It has been already shown that the transverse heal readily, but with respect to the longitudinal, they have a contrary tendency." In illustration of this assertion, he cites two experiments by Dr. Thomson, of Edinburgh, in which death occurred from the extravasation of fæcal matter, in less than forty-eight hours. The wound in each was an inch and a half long, and closed by four interrupted sutures, with the precaution, in one, of sewing up the interstices with a fine thread. In an experiment performed by himself, in which the incision was of the same length as in the preceding cases, and in which he had recourse to the continued suture, the animal recovered.

My own experience by no means coincides with that of the great English surgeon. We have already seen that, in the twenty-seven experiments above detailed, there were only two deaths, notwithstanding the great extent of the wound in some of them. I have no reason to believe, as Sir A. Cooper apprehends, that the sewing up of a longitudinal wound produces a greater degree of constitutional irritation than that of a transverse one; at all events, I have never witnessed any result of the kind. The experiments which he adduces from Dr. Thomson in support of his opinion were evidently not executed with the requisite precaution. A wound an inch and a half long cannot, as a general principle, be returned with safety into the abdomen with only four interrupted sutures; fæcal effusion will be almost inevitable, especially if the canal happen at the time to be loaded with ingesta, or if the animal be permitted to take much drink or food after the operation. In the second experiment the dog died, not because the parts had not been duly approximated in the first instance, but because the sutures, interrupted as well continued, had lost their hold, and

* Anatomy and Surgical Treatment of Hernia, p. 51.

thus allowed the wound to gap, and the fæces to escape into the peritoneal sac. In the experiment performed by Sir A. Cooper himself, in which the edges of the solution of continuity were secured by the uninterrupted suture, no effusion could occur, and the consequence was that the animal quickly recovered.

The conclusion, therefore, which I would draw from my researches is, that longitudinal wounds, instead of uniting less easily than transverse, generally adhere with more facility, that they do not produce a greater degree of constitutional irritation, or local disturbance, and that they are not more liable, if as much so, to be followed by contraction of the caliber of the tube at the seat of the injury. The same remarks I consider as applicable to oblique wounds. In nine cases of this kind, treated by the continued and interrupted suture, or by the method of Lembert, there was not a single death, any unusual symptom, or any diminution of the affected cylinder.

CHAPTER III.

Of the Treatment of Wounds of the Intestines by Ligation and Excision.

In operating for sphacelated hernia it occasionally happens that the constricted bowel contains a small aperture, caused either by the strangulation, or by the efforts which the surgeon is obliged to make to effect the reduction. The gut may also be accidentally wounded by the knife in attempting to divide the stricture, by neglecting to draw down the sac, and holding up the abdominal muscles. A number of examples of this kind are mentioned by authors. One is recorded by Mr. Lawrence in his *Treatise on Ruptures*, and another, which occurred in the practice of Cloquet, is cited in a previous part of this inquiry. When this accident happens, and the aperture is small, Sir Astley Cooper advises a treatment somewhat different from that which is proper when the tube is mortified in its entire circumference. Instead of excising the affected parts, and bringing the edges together by means of the suture, the surgeon should pinch up the margins of the opening with a pair of forceps, and then include them in a fine silk ligature, drawn sufficiently tight to divide the mucous membrane. The bowel should afterwards be returned to the mouth of the sac, and the case managed upon general principles. The preternatural orifice must not be more than three or four lines in diameter, otherwise it will not only be difficult to prevent the ligature from losing its hold, but the operation will be likely to be followed by undue and injurious contraction of the gut.

The following experiments and cases will exhibit this operation in a more forcible point of view. Of the latter, two occurred in the hands of Mr. Lawrence, the other in those of Sir Astley Cooper, with whom, I believe, the practice origi-

nated, and to whom surgery is indebted for some of its most ingenious and substantial improvements.

EXPERIMENT I.—Having opened the abdomen of a small slut, and exposed a fold of the ileum, I made an incision, half an inch in length, along its convex surface, and secured it by means of a strong silk ligature tied firmly round its sides. Some difficulty was experienced in preventing the thread from slipping; it was drawn with considerable firmness, and when the ends were cut off it was found to be nearly concealed from view by the apposition of the serous surfaces. The bowel was then returned, and the outer wound closed in the usual manner. The animal did not appear to mind the operation, which was soon over, and she was permitted to live until the ninth day. It is unnecessary to mention all the particulars of the post-mortem examination. Suffice it to say that the small intestines were slightly agglutinated to each other and to the omentum, and that the latter projected into and assisted in closing the outer wound. The bowel at the seat of the injury was remarkably firm, and presented numerous red points. The ligature had disappeared, and the edges of the wound were about three lines apart at their centre, without any contraction of the caliber of the tube. The bottom of the wound was consequently formed by a neighboring convolution protected only by a thin layer of lymph of a yellow-greenish appearance, from the admixture evidently of bilious matter.

EXPERIMENT II.—The incision in this experiment was transverse instead of longitudinal, but of the same extent as in the preceding. It was situated in the small bowel, about two feet from the ileo-cæcal valve, and the difficulty experienced in encircling it was still greater than in the former case. One end of the ligature being cut off near the peritoneal surface, the other was brought out at the external wound, which was closed in the usual way. The animal, a small pup, soon recovered from the shock of the operation, and was killed twenty-three days after, the ligature having been detached towards the end of the first week. The outer wound was completely cicat-

trized, with a process of omentum adherent round its margins, as well as to the convolutions of the small intestines. The latter were strongly united to each other at several points, particularly at the seat of the injury, which was almost perfectly repaired, the mucous membrane being deficient over a space not exceeding the diameter of a split pea. The bowel retained its normal dimensions, and the animal was in good condition at the time he was killed.

CASE I.*—John Shall, sixty years of age, was admitted into St. Bartholomew's Hospital, on the 2d of November 1826, with strangulated inguinal hernia. The tumor was hard and painful, the abdomen was tender on pressure, and there was a sense of tightness across the navel, with constant nausea and occasional vomiting. The pulse was small and frequent, and the symptoms in all respects urgent. All attempts to replace the parts by the taxis having failed, Mr. Lawrence proceeded to operate eight hours after the bowel had come down. The swelling contained a portion of small intestine in front with a large mass of omentum behind, and the stricture was caused by the neck of the sac, which encircled the protruded tube like a tight cord. On withdrawing the intestine gently, an opening was discovered in it just above the part that had been compressed, and which had probably been made by the bistoury in dividing the stricture. The sides of this aperture, which was very small, being held with the dissecting forceps, a ligature was firmly tied around it, after which the ends were cut close to the knot. A piece of omentum, which had been long protruded, and which it was found difficult to return into the abdomen, was removed with the knife, and the divided vessels, six or eight in number, secured in the usual manner. The integuments were brought together by three or four sutures, assisted by strips of adhesive plaster. Soon after the operation the bowels were evacuated with senna, and blood was twice taken from the arm. On the 6th of November the sutures

* Lawrence's Treatise on Ruptures, p. 301-3.

were removed from the outer wound, and on the 13th the ligatures came away from the omentum. It is needless to add that the patient rapidly recovered.

CASE II.—In another case, in which the bowel was wounded, Mr. Lawrence * pursued the same method. It was a large enterocele with the intestines greatly distended and the abdomen so very tense that it was difficult to replace the parts and prevent them from re-descending. The symptoms were not relieved by the operation, and death ensued within two days. The ligature was completely covered by a thin smooth layer of lymph, and so concealed that there was difficulty in finding it: the small wound in the bowel was closed.

CASE III.—Joseph Curtis, a butcher, twenty-one years of age, was brought into Guy's Hospital, on the 9th of December, 1808. He had a tumor in his left groin, which was very hard and tense, and gave considerable uneasiness on pressure. Along with this was violent pain in the stomach with vomiting of green bilious matter. Various attempts were made at reduction, but they all failed, and the operation was therefore at once determined upon by Mr., afterwards Sir Astley Cooper. About four inches of the small intestines were found in the sac, of a dark reddish color, with the testicle at the lower part. The stricture, situated at the mouth of the sac, was divided in the usual manner; a fluid of a yellowish appearance escaped, and on turning up the gut an opening was discovered, which was immediately laid hold of with a pair of forceps, and tied with a ligature. The parts were then returned, and the abdominal wound secured by five stitches assisted by adhesive strips. The patient bore the operation well, and seemed much better after it. For the first ten or twelve days, however, his sufferings were severe, but he gradually surmounted them, and was discharged cured on the 17th of January, 1809, a little more than three months after his admission.†

* Op. cit.

† The Anatomy and Surgical Treatment of Abdominal Hernia, Part i, p. 45. Second edition.

In commenting on this case, Sir Astley Cooper uses the following language: "We had the pleasure and satisfaction to see the patient completely recovered from an operation, the circumstances attending which were remarkable, and such as will tend to throw much light upon a subject hitherto but little understood."

The above plan, so happily employed by Sir Astley Cooper and Mr. Lawrence, has doubtless been adopted, if not actually executed, by numerous other surgeons. "Many years ago," says Prof. Gibson,* in speaking of Sir Astley Cooper's procedure, "I performed a similar operation in a case of hernia, and with equal success." Mr. Syme, of Edinburgh, recommends the same practice;† which may now, indeed, be considered as being fully sanctioned both by observations on the human subject and experiments on the lower animals.

Such is the treatment which should undoubtedly be pursued by the surgeon when he meets with an aperture of small size in the strangulated bowel. When the gangrene, however, involves the entire cylinder of the tube, a different mode of management must be resorted to. Under these circumstances, the affected parts should either be excised, and the edges approximated by suture; or they should be freely opened, and maintained in contact with the abdominal wound, to afford a ready outlet to the fæces. The experience of the profession has not yet fully determined, I think, which of these methods should be adopted to the exclusion of the other, or whether both are not occasionally justifiable. Several examples have already been cited in which excision was practised with the most complete success. The memorable case of Ramdohr is of this kind. An analogous one is recorded by Baudens, and mentioned under the head of Lembert's process of sewing up wounds of the intestines. The case which occurred in the hands of Dieffenbach is also in point. The sphacelated part was at least three inches in

* Institutes of Surgery, vol. i, p. 119. Philadelphia, 1838.

† Principles of Surgery, p. 262. Second edition.

length; the whole of which was removed with the knife, and the divided extremities secured by suture. The man lived nearly a month after the operation, and would have completely recovered but for some imprudence in his diet. In another case four inches of mortified intestine were removed, and the patient, a young man, recovered.* Many examples of a similar description are on record, but it is not necessary to refer to them more particularly in this place.

The practice of excision derives support from what is occasionally witnessed in intus-susception of the intestines, in which large pieces of the tube are detached without any detriment to life. In my museum of morbid anatomy is a preparation of this kind, presented to me by my friend Dr. Dawson, of Ohio, in which a portion of the colon, twenty-nine inches long, was discharged by a child six years of age, who, notwithstanding, made a most rapid recovery. This patient, as I have been recently informed, is still living and in perfect health, three years after the above occurrence. Thirty-five cases of a similar nature, collected from the writings of different pathologists, have been reported by Dr. Thompson of Europe.† The length of the eliminated pieces varied from six inches to upwards of three feet: they generally involved the whole cylinder of the bowel, and nearly all had a portion of mesentery attached to them. In one instance there was a mesenteric ganglion, in another a process of omentum. The average duration of the disease was between four and five weeks. In twenty-two of the cases the evacuated portion appertained to the small bowel, in the other to the large, or jointly to this and to the former. The cœcum was affected alone in one instance, the colon in two, the jejunum in three, the ileum in eleven.

The following case may be adduced as throwing additional light upon this interesting and important subject. It occur-

* Sir A. Cooper on Hernia, p. 37.

†Edinburgh Medical and Surgical Journal, Oct. 1835.—See also the author's Elements of Pathological Anatomy, vol. ii., p. 260.

red in the practice of Dr. McKeever, of Dublin, and will be found recorded in the fourth volume of the London Medico-Chirurgical Review.

A young robust woman, after having been in labor for upwards of thirty hours, was delivered with the crotchet, on the 29th day of July, previously to which a rent had taken place high up in the posterior part of the vagina, which extended round the neck of bladder, and communicated freely with that viscus. On the following day, in the afternoon, one of the attendants observed a shining substance hanging from the external parts, which was found, on the fifth of August, when Dr. McKeever first visited her, to be nearly a yard and a half of her small bowel coiled up under her, black, apparently putrid, and full of openings. Her belly at this time was much swollen, and excessively painful; her stomach rejected even the mildest articles of diet; the bowels were still obstinately confined; the pulse was small, intermitting and tremulous; and her countenance was pallid and ghastly: in short, she had every appearance of being in a moribund state. It being too late to return the parts, the treatment was merely palliative. On the following day, the protruded portion of the intestine had a soft doughy feel, was more shrivelled, and, instead of being black and livid, it was of a dirty ash-color. The constitutional phenomena were as before. On the seventh day the mortified parts, measuring precisely three feet and eleven inches, were detached, and the woman was nearly free from alarming and distressing symptoms. The vomiting and hiccough had ceased, her pulse was regular and of good strength, the countenance much improved, and the abdomen, though still much swelled, less tender to the touch. She had also a copious discharge of fæces by the vagina, being the first alvine evacuation she had since her delivery.

From this time she gradually mended. Her countenance improved, the secretion of milk became abundant, and the excrementitious matter was of a healthy color, smell and consistence. Three years after the occurrence of the acci-

dent, she could walk a dozen miles without inconvenience, and had become fat. For two years after her confinement she had no discharge whatever from the rectum, the residue of her food being altogether voided by the vagina. About the end of that period, however, she was attacked with violent bearing-down pains, accompanied by tenesmus, and after half an hour's severe suffering, she passed by the natural route a large quantity of dark, pitch-colored fæces, of the consistence of balls of firm wax. It is unnecessary to give further particulars. Suffice it to say that the woman was afterwards safely delivered of a small child, and that the fæces have ever since been discharged in the natural way.

The above case requires no comment. It is, in all respects, one of the most extraordinary on record, and affords convincing proof that injuries attended with the loss of large portions of the alimentary canal, are not necessarily fatal. Coxe's Museum contains a case, from the London Philosophical Transactions, of a boy who had his bowels protruded, and fifty-seven inches cut off by a cart, who, nevertheless, recovered his health in six or seven months.

To these observations I add the following experiments as having a direct bearing upon the subject under consideration.

EXPERIMENT I.—From a small but full-grown dog two inches and a half of the ileum were removed, near its junction with the large bowel, after which the edges of the wound were brought together with six interrupted sutures, introduced equidistant from each other, and made with a common needle and fine silk. The extremities of the ligatures were cut off close to the knots, and the parts being restored to their natural situation, the abdominal wound was secured by several stitches. Several ounces of blood—perhaps four or five—were lost during the operation, and the animal appeared to be somewhat faint. In the evening he was dull and drowsy, and indisposed to move about; but in the morning he was observed to be better, and from that time he rapidly recover-

ed. Four months afterwards, being in good health, and the outer wound perfectly healed, he was killed. Externally the bowel was smooth and natural, with no trace whatever of the former injury, excepting the attachment of a very small process of the epiploon. Had it not been for this circumstance it would have been exceedingly difficult, if not impossible, to find the seat of the wound. The mucous membrane was of the natural color; there was not the least contraction of the tube; and the situation of the breach was indicated merely by a very narrow oblique line or depression. No adhesions existed between the bowels or between them and the walls of the abdomen. See pl. fig. 8.

EXPERIMENT II.—In a second experiment five inches of the ileum were excised, and the lips of the breach maintained in contact by seven interrupted sutures, with the ends cut off close to the serous surface. The divided mesenteric vessels bled so freely during the operation that it became necessary to secure them with a ligature, which, however, lost its hold in attempting to replace the bowel. The dog, which was small, and not more than about a year old, died in thirty hours from the protrusion of eighteen inches of the small bowel, which was lacerated near its middle, of a dark livid complexion, and apparently sphacelated. Externally the wounded surface was slightly coated with plastic lymph, as well as partially covered with adherent omentum, and the parts above and below were of a deep rose tint. The mucous lining immediately around the seat of the injury was of a purple color; and there was a small coagulum where the ligature had slipped from the mesenteric vessels. No fæcal matter had found its way into the peritoneal cavity; the sutures had retained their situation; the lips of the wound were in contact with each other, both internally and externally; and it was obvious enough that the animal had perished from the protrusion and consequent inflammation of the ileum. The cause of this accident was the premature detachment of the stitches in the outer opening.

EXPERIMENT III.—Finally, in a third experiment the portion of ileum cut away measured eleven inches and a half. The edges of the divided extremities were brought together, and maintained in apposition by means of the continued suture, made with fine sewing silk, well waxed, and armed with a delicate needle. Several of the mesenteric arteries were surrounded with a ligature, which was brought out at the orifice in the wall of the abdomen. The dog, large, and several years old, became sick soon after the operation, which was both tedious and painful; at the expiration, however, of twenty-four hours he took food, appearing lively and even cheerful. He continued thus until the eighth day, when he was observed to be seriously indisposed, and early on the following morning he died.

On inspection, the inner lips of the wound were found to be in a soft, pouting condition, slightly covered with mucous, but no fæcal matter, and without any perceptible attempt at restoration; the suture was still in its place. Three folds of the intestines were glued together at the seat of the injury, and the parts there were somewhat red, as the effect of inflammation. Numerous petechial spots were observed upon the parietal portion of the peritoneum; and the serous and muscular tunics, both of the small and large bowel, presented, in several situations, a singularly lacerated aspect. The villous membrane in the vicinity of the wound was softened, and covered with a considerable quantity of thick, ropy mucus. The stomach and other organs were healthy. There was no obstruction from fæcal matter, or any contraction of the caliber of the tube.

It will be seen from the foregoing statements that only one of these experiments terminated favorably, namely, the first, in which the excised portion of intestine amounted only to two inches and a half. In the second, the animal might possibly have recovered had not the sutures of the external wound given way, and thus permitted the escape of the bowel, which was subsequently lacerated, and seized with violent inflammation. In the third experiment, in which

nearly one foot of the intestine was removed, the dog seemed to suffer severely from the shock of the operation; and, although re-action soon took place, he finally perished, on the ninth day, from the effects of his wounds. How the laceration of the serous and muscular tunics of the large and small bowels was induced, it is impossible to conjecture; nor is it easy to determine how far, or in what degree, it influenced the fatal event.

In two experiments of this kind by Dr. Smith of St. Croix, the results were of the most gratifying nature. In one, the excised portion of the small intestine—probably the ileum—measured two inches; in the other, two inches and a half. In both cases he made use of four interrupted sutures, placed at equal intervals, with the ends cut off at the knots. The animals were killed on the twentieth day, when the union was found to be so perfect that it was difficult to discover the seat of the injury. In one, all the ligatures were detached; in the other, one still remained.

The results of these observations and experiments are in the highest degree interesting, as they tend to establish an important practical precept. Cases occasionally occur in which the bowel is so much injured, cut, bruised or lacerated, as to be inevitably followed by gangrene, if the parts be not promptly excised, and treated in conformity with the principles here laid down. In extensive mortification from strangulation it becomes, as we have already seen, a question whether the affected portion should be removed by the knife, or the separation of it be intrusted to the efforts of nature. In the latter case, even supposing that the patient would run no risk from the effusion of fecal matter into the peritoneal sac, he would still be subjected to that most loathsome of all diseases, an artificial anus; in the former, the injured structures would be placed in the same relations as those of a common incised wound, and the chances of recovery would therefore be incomparably greater. In intus-susception, where one portion of bowel falls into another, and where the included piece is finally detached by sloughing, nature performs the same

operation precisely that the surgeon does under the circumstances in question, with the difference merely that she is much longer in accomplishing her object; which, however, is not less effectual in the end. The practice, then, would seem to be sanctioned, not only by reason and analogy, but by experiments on the inferior animals and observations on the human subject.

Would it be good practice, in extensive longitudinal or oblique wounds, to excise the affected part, and treat the case like one in which the tube is completely divided in the first instance? My opinion is that it would, especially where the opening is more than two inches in length. My reason for this conclusion is, that wounds of this extent require an unusually long time to heal, that the canal may become permanently contracted, and that the adhesive process is rarely so perfect as when the aperture is smaller. In addition to this, as was before remarked, there must necessarily be more irritation from the great number of sutures, to say nothing of the immediately bad effects occasioned by the protracted manipulation necessary to apply them. In an experiment, the particulars of which are detailed in another page, and in which the wound was three inches and a half long, death was evidently produced by the ulcerative action of the adventitious substance which formed the bottom of the opening, and which was consequently in direct contact with the contents of the tube. The abnormal aperture was nearly the size of half a dime. The animal lived till the end of the thirteenth day, and was considered entirely out of danger, when the perforation occurred which led to his death. Altogether eleven sutures had been used, of which only two remained. This case, although a solitary one, is sufficient, I think, to show the impropriety of employing so many sutures, or, rather, the inexpediency of attempting to save the affected part in extensive injuries of the intestinal canal.

Littre, an old French surgeon, was of opinion that the best practice, when the bowel is completely severed, whether by accident or mortification, is to bring the superior end out at

the external opening, for the purpose of establishing an artificial anus, and to return the other into the peritoneal cavity, having previously tied it to effect its obliteration. The inevitable result of such a procedure would be to consign the patient to a miserable existence, as it would deprive him of all chance of recovery, and leave him with an infirmity that renders him disgusting to himself and to those around. It really becomes a question, as has been justly observed by Mr. Lawrence, whether life itself be desirable, if burthened with the discharge of fæces through the groin or some other region.

A more rational and less objectionable method was proposed by La Peyronie. It consists in passing a double thread behind the wound through a fold of the mesentery, and retaining the ends of the bowel at the outer aperture, by fastening the extremities of the ligature to the surface of the abdomen with adhesive strips. This operation, like that of Littre, is always followed by an artificial anus; but, instead of being rendered incurable, as necessarily happens in the latter case, it generally yields to judicious management. Several examples in which this expedient was successfully resorted to are on record. I select the following as one of the most recent and interesting.

A man at the assault of Cairo, in 1799, was wounded by a ball in the abdomen, which entered on the right side, and perforated the ileum. The two ends of the bowel were ruptured, separated from each other, and tumefied; the superior being turned upon itself, so that it looked like the præpuce in paraphymosis, and caused complete obstruction of the tube. By four small incisions with the crooked scissors, Baron Larrey, the reporter of the case, divided the neck of the strangulated intestine, and restored it to its proper situation. He then passed a ligature into the portion of the mesentery corresponding with the two ends of the canal, which he returned as far as the edge of the wound, which he had previously taken care to dilate. After dressing the parts, he waited the result. For the first few days the symptoms were unpromising, but they gradually abated in severity, the alvine

evacuations daily improved, and in about two months the ends of the ileum were in apposition and ready to adhere. The wound was afterwards dressed with a plug, according to the ingenious plan suggested by Desault, and the soldier ultimately left the hospital completely cured.*

In a case mentioned by La Peyronie himself, the patient was about sixty-three years of age, and the bowel was affected with mortification from strangulation. The whole of the sphacelated part was cut away, and a thread passed through the mesentery, by which the ends of the gut were kept in apposition with the external opening. The fæces were voided through the artificial anus until the thirty-sixth day, when they began to resume their natural route, and in four months the ulcer was completely healed. Subsequently, however, an abscess formed at the seat of the cicatrice, followed by a new rupture.†

The practice commonly pursued by surgeons, when the bowel is mortified in its entire cylinder, is to pull it gently down, and make a large incision into it, to afford a free outlet to the fæces. The artificial anus thus established gradually diminishes in size, and after some months disappears, the alvine matter, in the meanwhile, resuming its natural route. Upon the propriety or impropriety of this practice it is not necessary here to insist. Further observation can alone settle the question. When there is much inflammation beyond the sphacelated parts, it would probably be wrong to pursue any other treatment; if, on the other hand, the tube is nearly, or quite sound, I should not hesitate to excise the mortified structures, and to approximate the ends by the suture, in the manner already explained.

* *Memoirs of Military Surgery*, translated by Dr. Hall, vol. i, p. 320.

† *Boyer, Traité des Maladies Chirurgicales*, T. viii, p. 136.

CHAPTER IV.

Of Artificial Anus.

It must be obvious that the term "artificial," applied to this affection, and in vogue among American and British authors, is rather ill chosen. In its etymological sense it merely implies some production of art, as an artificial leg, or an artificial eye; while in surgical language it denotes the effect of some operative or mechanical procedure, as the formation of an artificial pupil. By most of the French writers it has been superseded, in reference to the present topic, by the word "preternatural", and this is unquestionably preferable, in all respects, as it is much more expressive of the true nature of the malady which it is intended to designate. Equally appropriate is the term "accidental," used by some of the continental surgeons. The word artificial, in fact, should be restricted to that form of the affection, in which the abnormal outlet is established mechanically, for the purpose of affording relief when there is some insurmountable obstacle in the rectum, or lower bowel. In employing the term "artificial," therefore, in connexion with the present subject, I am governed rather by the established usage of the profession than by the rules of sound criticism.

Artificial, accidental, or preternatural anus may occur in any part of the abdomen; but, as it is generally produced by gangrene of the bowel, from the pressure which is exerted upon it by hernial stricture, it is by far most frequently met with in the inguinal, scrotal, femoral, and umbilical regions, particularly the first two. For the same reason we find that the small intestine is much oftener involved than the large, which is fixed or attached, while the former is loose, floating, and consequently more liable to protrusion. Occasionally, though rarely, the abnormal anus has its seat in the lumbar region, high up in the iliac, the hypochondriac, or even the epigastric.

Three causes mainly give rise to this affection, namely,

strangulated hernia, accompanied with mortification of the bowel, penetrating wounds, and stercoraceous abscess; the frequency of their occurrence being in the order in which they are here enumerated. A blow or kick on the abdomen may so contuse, bruise, or injure the bowel as to lead to the establishment of an artificial anus. Jobert saw a case in which an opening was formed in this way between the ileum and the vagina,* and examples of a similar kind have been witnessed by others.

When the bowel is extensively divided by a sharp instrument, and the wound is managed improperly, or left to itself, the patient either perishes from peritoneal inflammation caused by fæcal effusion; or adhesions take place between the gut and the adjacent parts, and the contents of the tube issue at the external orifice. The latter always happens when this accident is treated in conformity with the method of Palfin, Bell, and Scarpa, who advise the inner wound to be kept in apposition with the outer, by a ligature passed through the mesentery.

Stercoraceous abscesses are induced by various causes; sometimes by ulcerative action, often by external violence, and occasionally by the irritation created by the presence of a foreign body, as a needle or pin, a fish or chicken bone, or a piece of coin. In either case, as soon as the matter is discharged, whether spontaneously or by the efforts of the surgeon, the fæces escape at the abnormal aperture, either wholly or in part, and the patient is affected, not merely as some have pretended, with an intestinal fistula, but with a genuine preternatural anus. Large fæcal accumulations have sometimes been mistaken for this kind of abscess; the knife or lancet has been plunged into them, and the disease in question has been the consequence, or the individual has died from peritoneal inflammation. Artificial anus is occasionally congenital, in which case it is usually seated at the umbilicus.

Mortification, like penetrating wounds, may affect the entire circumference of the bowel, or only a part of it. The

* *Maladies du Canal Intestinal*. T. ii, p. 95.

extent of the lesion will exert a material influence upon the restorative process, and in this respect the disease might not inappropriately be divided into partial and complete.

The external orifice of an artificial anus exhibits no uniformity in respect to its size and configuration. In many cases it is rounded, in some ovoidal, and in most irregular. In its diameter it varies from a few lines to an inch and a half or even two inches; being usually smaller in traumatic cases, or in such as result from penetrating wounds, than in those which are produced by ulceration, abscess, and especially by gangrene. The margins of the opening are thick, bevelled, depressed, or inclined towards the centre, where they are in close contact with the mucous membrane of the two ends of the bowel, the junction between them being indicated by a reddish line; they have a raw, flesh-colored appearance, and are covered with numerous granulations, which are often very painful, and so irritable as to bleed upon the slightest touch. The matter which they secrete, and which is seldom very abundant, does not differ from that of other sores under similar circumstances. In cases of long standing, or where the fæcal discharges are unusually acrid, the edges are very much indurated, inflamed, highly sensitive, and studded with fungous vegetations, some of them the size of a split-pea, or even half a dime. In a third series of cases, perhaps, they are elevated, hard, and almost insensible. The skin in the immediate vicinity of the opening, as well as for some distance beyond it, is red, inflamed, chapped, fissured, excoriated, or ulcerated, and so tender frequently that the patient cannot bear to have it touched, wiped, or washed, however gently this may be done.

The depth of the outer orifice, or the distance between the skin and the bottom of the intestinal aperture, varies from three to twelve lines. It is always less when the disease is produced by a wound than when it is caused by gangrene; much will also depend upon the natural thickness of the wall of the abdomen, and the degree of plumpness or emaciation of the individual. Lallemand met with an instance where the distance between the two points was nearly two inches,

and in another, which fell under the observation of Delpech, it was upwards of three inches.*

The external orifice is occasionally multiple, that is, instead of a single opening there are several. In this case there are usually fistulous tracks, which communicate with the main outlet, and sometimes even with each other. Velpeau mentions an instance in which there were not less than five or six distinct apertures, and another, not less remarkable, is related by Dupuytren.† This perforated and cribriform state of the parts is generally produced by some of the stercoraceous matter insinuating itself among the muscular fibres and cellular substance of the abdomen before the margins of the external orifice are sufficiently protected by the new adhesions. An abscess soon forms, preceded by an erysipelatous blush of the skin, and followed by a discharge of purulent matter, almost insupportably fœtid in its character.

The union between the two ends of the bowel and the circumference of the outer orifice is effected through the medium of plastic matter, and constitutes an indispensable element of the disease. The inflammation, preceding and accompanying the effusion, always begins in the serous surfaces of the parts, from which it gradually extends to the other structures, as the mucous membrane, the muscles, cellular substance, and the skin. The plastic matter, soft and glutinous at first, is soon organized, and thus opposes an effectual barrier to the effusion of fœcal matter into the abdominal cavity. Subsequently it undergoes all the changes that lymph experiences, under favorable circumstances, in other situations. The extent of this adhesion varies, in different cases, from half a line to a line; it rarely amounts to half an inch, or, indeed, even the fourth of an inch, and in proportion as it is firm or otherwise will it be able effectually to resist the influence of such causes as have a tendency to separate the gut from the wall of the abdomen. Dupuytren met with two cases in which the union was so feeble that the intestine lost its hold, and the patients died from fœcal effusion.

* Dict. de Medicine, T. iii, p. 347.

† Dict. de Medicine, T. iii, p. 346.

When the artificial anus supervenes upon strangulated hernia, the formation of these adhesions usually precedes the death of the bowel; in the traumatic variety of the affection, on the contrary, they are established after the reception of the injury, and hence the greater frequency of fatal effusion in the latter than in the former. As the adhesions extend only a small distance along the gut, a cul-de-sac is formed, the opening of which looks towards the belly, and into which the abdominal viscera may protrude, so as to complicate the disease.

Immediately around the inner margins of the outer orifice are, as was previously stated, the two ends of the bowel; lying generally side by side, like the tubes of a double-barrelled gun. Each opens by a distinct orifice, of which the upper, in time, becomes much the larger; they are bounded by a sort of villous rim, are irregularly rounded in their form, and are separated from each other by a septum or partition. The upper orifice gives passage to the fæces, and, as it is unprovided with a sphincter muscle, the patient has no control whatever over their escape. Even mechanical means will not always obviate this inconvenience, and the utmost attention to cleanliness does not defend the surrounding parts from the effects of the acrid discharges. The lower orifice, of the same size at first as the upper, is generally very narrow, puckered up, and sometimes even difficult to be found, especially when it has ceased for a long while to receive fæcal matter. The upper opening is temporarily closed when the corresponding extremity of the bowel is touched with a probe or finger, or exposed to a few drops of cold water. When thus irritated it presents very much the appearance of the anus of the horse, the mucous lining being everted and corrugated by the peristaltic action of the muscular fibres.

The two ends of the bowel, at first similar in size, by degrees undergo important changes. The upper continually giving vent to fæculent matter, bile, mucus, and even ingesta, receives a preternatural quantity of blood, and hence generally acquires a considerable increase of volume and strength; its coats are thicker than in the normal state, the muciparous

follicles are larger, the lining membrane is of a deeper red, and the peristaltic action is inordinately energetic. The lower extremity, on the contrary, having no longer any active function to perform, falls into a state of atrophy. Its tunics are pale, flaccid, and attenuated, its caliber is considerably diminished, though not obliterated, and its mucous glands are wasted and almost imperceptible. The canal contains a soft, whitish, gelatinous looking substance, which is evidently the product of an imperfect secretion, and which is voided by stool at intervals of two, three, or four months. The intestine, notwithstanding these alterations, still preserves its tubular form, however long the fæces may have been discharged through the abnormal aperture. That this is the fact has been proved by repeated dissections. Thus, Lecat examined the body of a female who had labored under this malady for twelve years, and in whom the inferior portion of the gut, or the part comprised between the natural and artificial outlet, was still pervious, though much contracted. Similar observations have been made by Desault and Dupuytren. The latter opened a patient, two years after the establishment of an artificial anus, and found that the tube not only remained pervious, but that it had experienced comparatively little diminution. The following case, however, observed by Mons. Begin, of Paris,* shows that the obliteration of the intestine, although extremely rare, is not impossible. The patient was eighty years of age when he died, and for more than half this period he had labored under an artificial anus, seated in the left groin, and communicating with the arch of the colon. The superior extremity of the bowel only opened at the external orifice, and gave passage to the fæcal matter. No aperture, corresponding with the other end, could be discovered either in the cicatrice or in the surrounding parts. The gut itself was converted into a hard, solid, whitish cord, not thicker than a common quill, which

* Dict. de Med. Chir. Pratiques, T. iii, p. 133.

passed to the left kidney, from which it descended, after several turns, to the anus, increasing somewhat in size as it approached its termination. The inferior part was still pervious, and contained a little whitish mucus; the upper for the length of six or eight inches, next to the abnormal aperture, was completely obliterated; and the intermediate portion was so contracted as scarcely to admit a small probe.

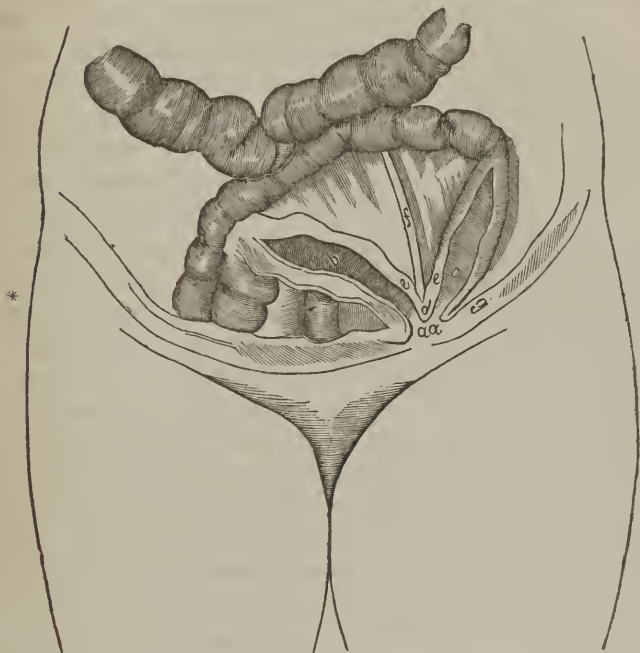
This atrophy or wasting is not confined to the lower portion of the bowel, but often affects the corresponding part of the mesentery and even the lymphatic ganglions. As might be supposed, it is always more marked in old than in recent cases.

In artificial anus, caused by a gangrened rupture, the two ends of the bowel are surrounded and closely embraced by a sort of membranous pouch, to which Scarpa, who first described it, has applied the name of *infundibulum* or *funnel*.* It is formed by the prolongation of the peritoneum which constituted the neck of the hernial sac, and varies very much in its shape, dimensions, and direction, its base being at the bowel, and the apex at the skin. It is generally very firm and dense in its structure, and from one to two lines in thickness, according to the extent of the previous inflammation; externally it is intimately united to the margins of the abnormal opening, and internally it presents a smooth villous surface, not unlike that of an old fistulous track. The fæculent matter from the upper orifice is poured into this cavity, and thence, when the artificial anus is closed, it is carried, after describing a half-circle, into the lower end of the canal. This membranous pouch is always wanting when the disease is the effect of a penetrating wound, and occasionally even when it is the consequence of a gangrened hernia: in both cases the gut adheres immediately to the edges of the opening in the muscles and integuments. The most interesting circumstance connected with this funnel-shaped cavity is the influence which it exerts upon the reparative process, or spon-

* Treatise on Hernia, Memoir Fourth, p. 233.

taneous cure, which is always so much the more prompt and perfect in proportion as it is larger and longer.

Interposed between the two extremities of the intestine, and formed by the juxta-position of their sides, is the *ridge*, *septum*, or *partition*, which Scarpa has described under the



name of the promontory, and Dupuytren under that of the *épéron*, spur, or buttress. It consists of two angular or crescentic folds composed each of four lamellæ, of which the inner two are of a serous nature, and firmly united together by plastic matter, for an extent varying from one to six, eight, or even twelve lines. The outer layers are of a mucous character, and are continuous with the lining membrane of the

* *aa*, Opening of the artificial anus, and point of union between the skin and the mucous membrane; *b*, upper end of the intestine; *c*, lower end of the intestine; *d*, the septum, *épéron*, or ridge, formed by the walls of the two contiguous cylinders; *ee*, parietes of the bowel; *f*, the ligament or cord formed by the mesentery; *g*, the cul-de-sac between the peritoneum of the intestines and of the abdominal walls, into which herniæ occasionally protrude.

tube, of which they form a part. Dividing the bottom of the funnel, where it is situated, into two unequal parts, this septum juts out nearer to the surface of the abnormal opening in proportion as the loss of intestinal substance has been more considerable, and the change in the direction of the tube more marked. It is small, and scarcely perceptible, when the gut has been merely pierced by a wound, or slightly affected by an eschar, but large and prominent, when the lesion, whatever it may be, involves the whole circumference of the canal.* In the former case, the two orifices of the bowel are separated by a kind of gutter or groove, which directs the transit of the fæcal matter from the one to the other, and greatly facilitates the attempts at cure; in the latter, the septum forms a projecting angle or buttress, which conducts the contents of the upper orifice towards the abnormal outlet, and which nothing but art can break down or surmount.

When the two lamellæ of which this septum is composed are viewed posteriorly, or from within the belly, we find that they gradually recede from each other, leaving thus a triangular interval between them, the apex of which corresponds to the point of separation, and the base with the abdominal cavity. The surfaces of these lateral layers, which are, in fact, nothing but the parietes of the affected cylinders of the bowel, are invested by a reflection of the peritoneum, and afford attachment to a process of the mesentery. From the manner in which this membrane is stretched between the spinal column and the concave side of the intestinal convolutions, it follows that it is always more or less dragged on when the gut is protruded from the belly, forming a sort of cord by which the body is inclined forwards, and the tube drawn inwards. A constant traction is thus kept up, which varies in degree in different cases, and which has occasionally been sufficient to destroy the adhesions between the bowel and the wall of the abdomen, causing fatal effusion into the cavity of the peritoneum.† Dupuytren, who has devoted

* Dupuytren, *Dict. de Med. and Chir. Pratiques*, T. iii, p. 130.

† Dupuytren, *Leçons Orales*, T. ii, p. 207.—*London Medico-Chir. Review*, vol. ix, p. 315.

much attention to this subject, states that this tension of the mesentery is continued long after the malady is removed. Several individuals who had been cured of artificial anus, were subsequently re-admitted into the Hotel-Dieu, where they died of other diseases. On dissection it was ascertained, contrary to what might have been expected, that the bowel, instead of being adherent to the walls of the abdomen, was free and unattached; a solid fibrous cord, however, being still stretched between them. This last was only a few inches in length by several lines in thickness, greatly attenuated at the middle, invested by peritoneum, and formed entirely of condensed cellular substance. Had these individuals lived a little longer this band would, doubtless, have been gradually destroyed, and every vestige of the malady ultimately disappeared.

The matter which issues at the abnormal opening varies in its properties according to the length of time it is retained in the bowel, the nature of the food, and the state of the patient's health. Generally speaking it is soft, semi-fluid, or even quite liquid, of a greenish color, and composed of an admixture of fæces, bile, and intestinal secretion, together with ingesta. Its consistence is always less when the artificial anus involves the jejunum or the superior extremity of the ileum than when it affects the lower portion of the small bowel, the cæcum, or the colon. In the former case, too, it has less stercoraceous odor, and occasionally contains a considerable quantity of pancreatic juice. The frequency with which it is voided is materially influenced by the nature and quality of the food, as well as by the manner in which it is prepared, and by the distance which intervenes between the abnormal aperture and the stomach. When the artificial anus is situated near this organ, it commonly passes off within an hour or two after eating, whereas, if it be lower down it may not be voided for five or six hours, or perhaps not oftener than three or four times a day. The evacuations, as was before intimated, are always involuntary, and are generally effected with considerable rapidity, being accompanied

with a peristaltic movement of the upper extremity of the gut and a sort of rumbling noise, especially when there is an escape of air.

The quantity of fæcal matter flowing along the abnormal opening, like its quality and the frequency of its discharge, must necessarily be influenced by a variety of circumstances. Of these the most important are the amount of food, the extent of the intestinal lesion, and the size of the septum between the two ends of the bowel. Most persons laboring under this disease eat voraciously, often, indeed, three or four times as much as they did before; they are always hungry, have an enormous appetite, and are never satisfied. This is particularly the case when the ingesta are retained only for a short time. Hence there is a proportionably large accumulation of fæculent matter, and as this cannot pass from one intestinal orifice into the other, in consequence of the mechanical obstacle interposed between them, most of it, if not all, escapes at the abdominal opening.

The pernicious influence which the brief sojourn of the alimentary matter exerts upon the system is not always so great as might be supposed. Indeed, not a few instances are related in which the patients not only retained their health and strength, but even grew fat. In the generality of cases, however, the effects are quite the reverse. The food is retained too short a period to be properly acted upon by the digestive organs; the function of chylicification is impaired; nutrition is carried on imperfectly; the body is emaciated, and there is a proportionable failure of the physical powers. In extreme cases, that is, where the general health is otherwise affected, or where the passage of the aliment is exceedingly rapid, the patient has sometimes perished from inanition.

Another very serious inconvenience to which persons laboring under artificial anus are subject is the protrusion of the extremities of the gut. This often amounts to a real prolapsus, and is liable to occur, no matter what may have been the cause of the disease. It may affect one or both

ends, but the upper is more frequently involved than the lower, though the reverse is said to be the case by Boyer, not, however, with any foundation in truth. The extent of the prolapsus varies, in different cases, from three to eight inches; more rarely it amounts to a foot, or even a foot and a half. In its diameter the tumor seldom exceeds two and a half or three inches. It is more or less conical in its shape, contracted at the base, and perforated at the extremity by an irregularly rounded opening. The everted mucous membrane is at first only preternaturally red and vascular; by degrees, however, it becomes thickened, rugose, indurated, and completely hypertrophied. In this respect it experiences the same changes of structure as the villous coat of the rectum in prolapsus of the anus. The swelling, which is commonly much larger in the erect than in the recumbent posture, frequently possesses so little sensibility that it may be touched or handled without pain. At times, however, it is excessively tender, and may then become a source of real suffering, depending more, perhaps, upon the state of the system than upon that of the part immediately concerned. Strangulation of the prolapsed intestine occasionally occurs, and, although the stricture by which it is produced, may generally be easily relieved by an operation, yet in several instances it has terminated fatally. Sabatier, in his *Memoir on Artificial Anus*, quotes two examples from Puy, a surgeon of Lyons, where death was caused in this way; an instance of a similar kind fell under the observation of Flajani, and another is mentioned by Le Blanc, in the second volume of his "*Operations de Chirurgie*." In a case narrated by Mons. Veiel,* the division of the stricture did not prevent death.

From this rapid sketch of the nature, anatomy, symptoms, and complications of artificial anus, it is obvious that, in whatever light it be viewed, it must be regarded as one of the most distressing affections to which we are liable. Independently of its filthy and disgusting character, the patient has

* Archives Generales de Medicine, 2d series, T. vii, p. 542.

scarcely a moment of comfort of any kind; the skin of the abdomen is constantly fretted and chafed, in spite of the utmost attention to cleanliness, the general health is often seriously deranged, the digestive organs are apt to become impaired, the bowels are frequently racked with colicky pains, the mind is gloomy and despondent, and life itself is a burden. Death is occasionally produced by inanition, or by the laceration of the new adhesions and the consequent effusion of fæcal matter into the peritoneal cavity; but these occurrences are rare, and more generally the patient lives in the manner mentioned, and is ultimately carried off by some other disease. The probability of spontaneous reparation, or a cure by surgical interference, will depend very much upon the seat of the complaint, the nature of the exciting cause, the freedom from complications, and the extent of the septum or partition between the two ends of the gut. It need hardly be stated that the age of the patient and the state of his health exercise considerable influence on the prognosis.

Treatment.

The treatment of artificial anus naturally divides itself into palliative and radical. The first consists in promoting the comfort of the patient, by strict attention to cleanliness, preventing too early an escape of the ingesta, and combating such accidents or complications as may arise during the progress of the malady. The radical treatment has for its object the re-establishment of the natural course of the fæces, and the obliteration of the opening in the wall of the abdomen. These topics involve important principles, and therefore require separate consideration.

It is a question which has not yet been definitively settled how soon, after the occurrence of an artificial anus, we are warranted in attempting a radical cure. Several examples are now on record where, by premature interference of this kind, the patients lost their lives. Death, under these circumstances, may be produced by a variety of causes, but the

most common, perhaps, is the want of adhesion in the sides of the opening which is made in the épéron or intervening septum, and the consequent escape of fæcal matter into the abdominal cavity. Another source of mischief is the imperfect union between the ends of the bowel and the margins of the abnormal outlet. Indeed, it appears to me that, until this union is fully established, or is so strong and firm as to render it impossible for it to give way under the traction of the enterotôme or the manipulations which are necessary to introduce the seton, it would be highly improper, with a view to a radical cure, to do any thing calculated to jeopard the result by fæcal effusion into the peritoneal cavity. We have no means, unfortunately, of ascertaining how soon the plastic matter, by which the union in question is effected, becomes organized, and capable of withstanding such forces as have a tendency to break up the new connexions. Nevertheless, there is reason to believe, from what we know in regard to the changes which coagulating lymph experiences in other parts of the body, that several months, probably from three to six, are necessary for the purpose. Prior to this period, therefore, I would deem any surgical interference officious und unadvisable, particularly in relation to the enterotôme of Dupuytren, or the modification of this instrument by other practitioners. The method of Desault, of which we shall presently speak, may be advantageously resorted to much earlier, and consequently before the adhesions between the contiguous parts have acquired all the strength of which they are capable.

There is, therefore, a period, unless a spontaneous cure should in the meantime supervene, of several months during which the patient must bear with his loathsome infirmity, and suffer all the inconveniences arising from the effusion of fæculent and other matters. This, however, is not all. The case may be such, as, by its very nature, to preclude the possibility of effecting a radical cure by any means of which we are in possession; or the patient may, from timidity or other causes, be unwilling to submit to an operation of any

kind. In either event, it is the duty of his attendant to make his situation as comfortable as practicable.

The first and most important object to be attended to, in a case such as we have imagined, is to prevent the escape of faecal matter at the artificial anus; or, if this cannot be done, to apply some apparatus for receiving and retaining it. When the disease has been caused by a wound, or when the bowel has been only partially destroyed by gangrene, the former of these indications is generally easily fulfilled by means of a piece of gum-elastic, several lines thick, shaped like a nipple-shield, and large enough not only to cover the external orifice, but to extend some distance beyond it. This, being soft and flexible, readily accommodates itself to the various movements of the body, and answers the purpose much better than leather, tin, brass, or sheet-lead, recommended by some surgeons. It should be retained by a graduated compress and bandage; or, what would be better, a common truss with a broad pad perforated in the centre for receiving the knob on the gum-elastic plate. To derive full benefit from this apparatus it might be so constructed as to have a projection on its posterior surface, carefully fitted into the abnormal opening, which it would thus more effectually close, at the same time that it would prevent the protrusion of the bowel, so liable to occur when the parts are imperfectly supported, or when the patient is in the erect position.

When the fæces can not to be made to pass along the natural channel, in consequence of the inordinate size of the septum between the two ends of the bowel, the patient may generally be rendered very comfortable by wearing an apparatus for their reception and temporary retention. The older surgeons were in the habit of using, for this purpose, receptacles of leather, or horn, which were fastened round the body by bandages of particular construction. These contrivances, however, rarely fulfilled the intention for which they were constructed, as it was found not only difficult to adapt them accurately to the parts, but from the facility with which

they imbibed moisture they soon became offensive, and required to be often renewed. The most perfect apparatus of this kind, perhaps, was constructed many years ago, by Juville, a celebrated Parisian truss-maker. It is delineated in his "*Traité des Bandages Herniaires*," and has occasionally been worn with great benefit. In its construction it is exceedingly complicated, and it is scarcely possible to convey a correct idea of it without a plate. It is composed of a common inguinal truss, the pad of which is made of ivory, and rests upon the margins of the artificial opening. To a hole in the centre of the pad is fitted a tube of gum-elastic, which is furnished with a valve, and directs the fæcal matter to a silver receiver, fastened to the inner part of the thigh. The silver receptacle is of a flattened conical shape; it is three inches in length by two inches and a half in breadth, and may be unscrewed and emptied without disturbing the rest of the instrument. The valve in the tube opens by its own weight when the patient is in the erect position, but shuts when he lies down, and prevents the accumulated fæcal matter from reflowing into the artificial anus. When the apparatus is properly adjusted it is said to answer so well that the patient is able to pursue his ordinary occupation, and to escape the inconveniences arising from the discharge of fæculent and other matter.

If, notwithstanding the use of an apparatus of this kind, the fæces are diffused over the surrounding surface, the utmost attention must be paid to cleanliness. Without this no comfort can be expected. If allowed to remain in contact with the skin, even for a short time, the acrid discharges not only induce pain and irritation, but they render the patient loathsome to himself, and disgusting to his friends. In fact, there is no situation in which a human being can be placed which is more pitiable and distressing, or better calculated to excite our sympathy.

When inflammation arises, either in the part itself, or in the neighboring integuments, it is to be combated by frequent ablutions, emollient poultices, and anodyne fomentations. If

t partakes, as it sometimes does, of an erysipelatous character, it may be necessary, in addition to these means, to use leeches and blisters. The callosities which are so apt to form on the surface of the sore should be removed with the knife or scissors; escharotics are to be avoided, as they always give rise to severe pain, and rarely afford much relief. When the skin is ulcerated, fissured, chapped, excoriated, or studded with pustules, it should be thoroughly cleansed with a soft sponge and tepid water, after which it must be anointed with simple cerate, and covered with a slippery-elm or linseed poultice. These dressings are to be continued as long as may be necessary, and renewed twice or three times in the twenty-four hours.

Fistulous tracks, when they exist, must be incised, and their edges pared, to put them in a condition favorable to cicatrization. The cure is sometimes much retarded, if not entirely prevented, by the perforated state of the parts; the skin, perhaps, is indurated and disorganized, and fæcal matter issues at various points, keeping up constant irritation and distress. In such a case it may become necessary to remove the affected structures, bowel and all, with the knife, to reduce them to the nature of a simple wound.

Inanition is seldom to be apprehended when the artificial anus is seated in the large intestine, or low down in the small. In either event, abundant time is usually afforded to the chyloferous vessels for taking up the nutritious portion of the ingesta, and conveying it to the proper receptacles, before the contents of the tube reach the abnormal outlet. When this, however, is situated higher up, the case may present a very different aspect, as the chymous matter may escape too soon to enable the system to be much benefited by it. This circumstance is always known by the soft and lactescent nature of the discharge, by the voracious appetite, and by the progressive emaciation. The patient eats three or four times the accustomed quantity of food, his hunger is never appeased, he is thin and haggard, and has but little strength. To support life, which is occasionally much endan-

gered by this occurrence, the individual must be kept perfectly quiet, the diet must be light, nutritious, and easy of digestion, the irritability of the bowels must be allayed by anodynes, and the outer opening must be well protected with an obturator. In bad and intractable cases, threatening life, advantage might be derived from the use of nutritious injections.

When the bowel becomes prolapsed, as it is apt to do when the opening is not properly closed, the reduction is usually effected with great facility, by placing the patient on his back, and making gentle and well-directed pressure upon the part with the fingers of one hand, while the bowel is held between the thumb and fingers of the other. In more obstinate cases, the replacement may be attempted by systematic compression, while the patient is lying on his back; this will have the effect of emptying the protruded gut of its blood, and will often succeed after other and more simple means have failed. When the reduction is impracticable, the gut should be supported by a well adjusted apparatus, and the patient should refrain from laborious exertion, from laughing and coughing, irregularities of diet, and from every thing tending to increase the swelling. When symptoms of strangulation arise, the most rigorous antiphlogistic measures are to be adopted; blood is to be abstracted, both generally and locally, the patient is to be placed in the warm bath, and cloths, wrung out of tepid water, are to be constantly applied to the affected part. In a word, the case is to be treated precisely as when the strangulation is produced by ordinary causes. When these remedies fail, relief must be attempted by an operation. The patient lying upon his back, near the edge of the bed, the surgeon takes a bistoury which he passes along the fore-finger of the left hand, and makes a free incision through the integuments around the base of the tumor, which is generally sufficient to remove the stricture. Should this, however, be found not to be the case, it will be necessary to extend the incision into the end of the bowel, at its union with the margin of the abdominal orifice. Soon after

the stricture is divided, the tension of the part subsides, the fæces flow out externally, the pain disappears, and the gut gradually becomes reducible.

Artificial anus is susceptible of spontaneous cure. Of this numerous examples are on record, and there is scarcely a surgeon, at all extensively engaged in practice, who has not met with cases of it. The fæces, after having passed for weeks or months through the orifice in the abdomen, gradually resume their natural channel, the artificial anus closes up, and at length all that remains is a small cicatrice, indicating the situation of the former injury.

A singular instance of artificial anus, in which a cure was effected during pregnancy, has been related by Dr. Wedemeyer of Hanover.* The woman was thirty-two years of age, and the disease, caused by a gangrened hernia, had existed for seven months, during which it had resisted various methods of treatment. As pregnancy advanced, and the uterus ascended into the abdomen, the fæcal discharge diminished, and passed proportionably along the natural route. Towards the close of gestation, nothing issued at the abnormal opening, except a little pus and serum, and in two months after her accouchement the parts had completely healed.

Before we attempt the radical cure of an artificial anus by any method of treatment, however simple, it is proper that some attention should be paid to the general health of the patient. If this be much deranged, it is obvious that it should be rectified, otherwise the case may proceed badly, or even terminate fatally. The secretions are to be restored; the diet is to be regulated; the bowels must be moved by mild aperients; and any local irritation that may exist is to be combated by frequent ablutions, anodyne fomentations, and emollient poultices. Leeches will seldom be necessary. This preliminary treatment is particularly called for when we wish to put in

* American Medical Recorder, vol. xiii, p. 453.

execution the operation of enterotomy, autoplasty, or even the more simple one of the seton.

When the abdominal orifice is too small to admit of the ready application of the enterotôme, the use of the plug, or the passage of the seton, it must be dilated with linen tents or gum-elastic bougies. The foreign substances should not be introduced too frequently, or too forcibly, or for too long a time; and their use should not be attempted until the parts are divested of their tenderness and irritability. By proceeding cautiously in this manner, taking care gradually to increase the size of the tent, the abnormal passage may generally be dilated to the requisite extent within from two to four weeks. When the edges of the track are very thick and callous, the treatment will be greatly expedited by excising them.

After the operation has been performed, the patient must for sometime lie quietly upon his back, with the legs and knees drawn up, to relax the abdominal muscles and prevent undue compression of the parts. The diet must consist of nourishing broths or light soups, soft boiled rice, tapioca, arrow-root, or boiled milk and grated cracker. For his drink he may use demulcent fluids, as gum water, or flaxseed tea; the bowels should be calmed by anodynes, and the natural stools promoted by stimulating enemata. In short, every thing is to be done to avoid inflammation, both in the parts more immediately concerned, and above all in the peritoneum.

Of the various operations that have been devised for the radical cure of this loathsome and disgusting affection, the first that attracts our attention is the suture. The idea of employing enteroraphy is generally supposed to have originated with Lecat. However this may be, it is certain that a female laboring under this infirmity was under the care of that celebrated surgeon in 1739, and would have been subjected to this treatment had she not become tired of the numerous attempts that had been made to replace the protruded and adherent gut.

The expedient was subsequently carried into effect by a surgeon of the name of Bruns; but instead of paring the edges of the opening, as had been suggested by Lecat, he contented himself with excoriating them with caustic. The case seemed to be going on favorably, when, on the third day, the ligature lost its hold, and the anus began to gape, followed by a discharge of fæcal matter. The patient, unwilling to submit to further trials, was abandoned to his fate.

The next attempt at this species of enteroraphy was made by Liotard;* but the result was not more fortunate. He pared the whole circumference of the abnormal aperture, and approximated the raw edges by two points of suture, aided by a favorable position and proper dressings. On the second day the apparatus was observed to be soiled by fæcal matter, and on exposing the parts the ligatures were found to have cut themselves out. Professor Blandin, of Paris, in a similar case, was equally unsuccessful. Indeed, Judey seems to be the only surgeon in whose hands the expedient has hitherto had a favorable termination: the artificial anus had existed four months, and the cure was complete.†

Desault, in the latter part of the last century, endeavored to cure this disease by compression.‡ He was aware that the chief obstacle to the reparative process was the septum between the two ends of the tube, by which the fæculent and other matters were diverted from their proper channel, and forced out at the preternatural orifice in the wall of the abdomen. The removal of this projecting piece constitutes, therefore, a most important indication in the treatment. To fulfil this, Desault used long linen tents, which he introduced and fixed in the two ends of the gut, taking care to renew them as often as they became soiled and offensive, which generally happened once or twice in twenty-four hours. In this manner he gradually effaced the abnormal angle, and

* Diss. Sur. le Traitement des Anus Contre Nature. Paris, 1819.

† Archives Generales de Médecine, T. i, p. 291.

‡ Surgical Works; Translated by Smith, vol. i, p. 306. Philadelphia, 1814.

brought the two cylinders into a straight line; at the same time he dilated the lower orifice, and thus placed it in a more favorable condition for receiving air and fæcal matter. Along with these means he kept the outer opening closed by a well-adjusted compress, for the two-fold purpose of preventing the escape of the fæces, and of forcing them on towards the rectum. When the dilatation was sufficiently advanced and the intervening septum nearly effaced, he discontinued the long tents, and merely retained the external plug, applying it more superficially lest it should interfere with the transmission of the contents of the tube, and so become an obstacle to the restorative process. If it succeeds, the good effects of this method are announced by slight colicky pains and rumbling noises in the belly, followed at first by a discharge of wind, and soon after by fæculent and mucous matter. In proportion as the natural passages are re-established the outer orifice diminishes in size, and the griping subsides. The cure is expedited by a light but nutritious diet, perfect rest, and an occasional enema.

Although this method of treatment has been repeatedly attended with the happiest results, it is obvious that it cannot be employed with a prospect of success in all cases. Of this Desault himself appears to have been fully aware, and he has enumerated the following circumstances as particularly calculated to oppose the cure, or as so many contra-indications: first, where the gut has suffered great loss of substance; secondly, where the intervening septum is too short, prominent, or difficult to be broken down; and thirdly, where the ends of the bowel, one or both, have contracted such firm adhesions externally as to render it impracticable to effect their reduction. In addition to these considerations it may be remarked that the process is generally very tedious, and well-calculated to exhaust the patience both of the surgeon and the sufferer.

The first instance in which Desault employed this mode of treatment is too interesting to be passed over on the present occasion. The case, in fact, has become memorable in the

annals of surgery. The following abstract of it is all that my limits will allow me to give.

Francis Vialter, a large, strong, and well-built man, a sailor and native of Moulins, was injured by the bursting of a bomb in May, 1786. The wound occupied the right side, and extended from about two inches above the inguinal ring to the bottom of the scrotum, where it had exposed the testicle. At the upper angle was a sort of appendix, very red, an inch long, and formed by the divided bowel, which retracted into the abdomen, whenever the parts were washed. In this situation an opening was left in the dressings for the discharge of the fæces. After having wandered about for four years, and visited all the principal hospitals of Europe in vain for relief, he entered the Hotel-Dieu of Paris, on the 29th of September, 1790.

The upper end of the bowel, from long exposure to the air, the friction of the clothes, and the contact of fæcal matter, had acquired considerable thickness, as well as density, and was of a conical shape, nine inches in length. Its base, which was somewhat contracted, seemed to proceed from beneath a fold of the skin, just above the inguinal ring; while the apex, inclined backwards, reached to the middle of the thighs, and ended by a narrow orifice, through which the fæces flowed. Nothing had escaped by the natural passage since the period of the injury, except a small quantity of whitish, ropy mucus, at intervals of three or four months. The whole surface of the tumor was red and wrinkled, like a villous membrane. On the outer side of this mass was another protrusion, much smaller but of the same color and consistence, oval in its form, and puckered like the mouth of a purse at the extremity, where it discharged a little serosity. The patient was extremely emaciated, and compelled, by the violent pains he experienced in the abdomen, to bend himself forward when he attempted to walk. An earthen pot, attached to the waist and suspended between the thighs, received the fæcal matter.

To reduce the swelling of the upper protrusion, without

which the bowel could not be restored to its natural situation, Desault used a simple roller, with which he covered the whole tumor from below upwards, by spiral and moderately light turns, leaving merely an orifice at the apex for the passage of the fæces. The effect of the treatment was extraordinary; the tumefaction rapidly subsided, and by the fourth day the intestine was in a condition to be replaced. Having accomplished this, he opposed the issue of the excrements by a thick linen tent, three inches long, introduced into the gut, and supported by an inguinal bandage. His idea was to remove this twice a day for the evacuation of the fæces; but in a short time the patient perceived a rumbling noise in the abdomen, accompanied with an acute sense of heat, and wind was soon expelled by the anus. Colicky pains occurred in the rectum, and half a pint of fluid matter was discharged by the natural route. The night following he had a number of evacuations of the same kind, preceded by similar feelings, and which left him somewhat languid in the morning. The passages became gradually more natural, the pains disappeared, and on the eighth day the tent was discontinued, the external opening being closed by a pledget of lint and several compresses, supported by a truss with a broad flat pad.

From this period Vialter rapidly recovered; he regained his flesh and strength, and voided his fæces without pain or inconvenience. A very trivial serous exhalation moistened, without staining, the lint which covered the *fistulous* orifice in the abdomen. Five months after he left the hospital, in attempting to lift a cask on his shoulders, his bandage broke, and the intestines again protruded, to the length of six inches, through the unhealed opening. The same treatment as on the former occasion was adopted with complete success.

A more effectual and less tardy expedient than that of Desault, was proposed, near the close of the last century, by Schmalkalken, a German surgeon. He has given an account of it in his Inaugural Dissertation, "*Nova Methodus Intestina Uniendi*," published at Wittemberg in

1798. The operation consists in perforating the septum with a seton introduced by means of a curved needle, and allowed to remain long enough to excite adhesive inflammation between the two contiguous cylinders of the bowel. The period necessary for this varies from a week to a fortnight, at the expiration of which the foreign body is withdrawn, and the portion of the partition lying between the outer orifice and the opening of communication excised with a pair of scissors or other suitable instrument. In executing the operation, it is of no little importance that the track made by the instrument is accurately filled by the thread or tape, otherwise faecal matter might be effused into the peritoneal cavity. The seton ought to be carried as high up as possible, and care taken that it do not embrace a neighboring fold of the intestine.

Whether Schmalkalken ever performed this operation, of which he must undoubtedly be regarded as the inventor, it is impossible for me to say, as I have not before me a copy of the dissertation in which the account of it originally appeared, nor do I find the subject mentioned in any other work. The probability is that he did not; at all events, very little notice of it was taken even in Germany, while the profession of the remainder of the continent of Europe, Great Britain, and the United States appears to have been profoundly ignorant of it. I make this statement for the purpose of showing that the late Dr. Physick, of Philadelphia, who performed a similar operation in 1809, was not aware that it had been previously proposed, and that he is therefore justly entitled to a share of the credit of the discovery.

The case which fell under the observation of Dr. Physick, and which was probably the first of the kind treated by the seton, was that of John Exilius, a Swedish sailor, nineteen years of age, who was admitted into the Pennsylvania Hospital in October, 1808, for strangulated congenital hernia.*

* See an account of this case, drawn up by Dr. B. H. Coates, and published in the second volume of the *North American Medical and Surgical Journal*—also Dorsey's *Surgery*, vol. i. p. 96.

The sac being opened, the two coils of the bowel were found to be firmly adherent to the testicle, as well as partially to the abdominal ring, and one of them presented an opening of sufficient magnitude to permit the discharge of a considerable amount of fæces. There were, however, no marks of mortification, and the perforation was probably caused by ulceration. The symptoms were but slightly relieved by the division of the stricture, the patient continued very restless, and only a small quantity of matter flowed through the wound. Another operation was therefore performed, followed by much greater facility for the escape of the fæces. On the 24th of December, the projecting portion of the gut was cut off close to the ring, in the hope that the open orifices thus left would gradually retract within the abdomen. No good, however, resulted from this procedure, nor did any better success attend the method of Desault, which was employed soon after. It now occurred to Dr. Physick that relief might possibly be afforded by cutting a lateral opening through the sides of the gut; but not knowing to what extent they adhered to each other, he determined to pass a needle armed with a ligature from one cylinder to the other, about an inch within their respective orifices. This operation was performed on the 28th of January, 1809. The ligature, applied with moderate firmness, was secured with a slip-knot, and drawn to its original tightness whenever it became loose by the ulcerative action of the parts which it embraced.

After three weeks had elapsed, the ligature was removed and the parts in front of the opening which it had made divided with the bistoury. No unfavorable symptoms supervened upon this operation; on the 28th of February the patient had uneasy sensations in the lower portion of the abdomen, and on the 1st of March he extracted with his own fingers some hardened fæces from the rectum. Other evacuations followed; the discharge from the groin became inconsiderable; and the artificial anus gradually diminished in size. The patient was dismissed from the hospital on the 10th of November, in good health, but with a *fistulous* aperture in

the groin, the hope of an entire closure being abandoned. By wearing a truss with a compress and a large pad, stuffed in the common way, the escape of fæces was completely controlled.

By the French surgeons the honor of the discovery of this process is generally claimed for Dupuytren, by whom it was executed at the Hotel-Dieu in 1813, without any knowledge apparently that it had been recommended by Schmalkalken, and performed by Physick.* His patient was Francis Auler, thirty-six years old, of excellent constitution, who had been affected from his youth with an inguinal hernia on the left side, from which, however, he had experienced no inconvenience until the 13th of May, when, in consequence of a violent attack of vomiting, it became strangulated. Five days after he was carried, in a state of great prostration, to the Hotel-Dieu, and the stricture carefully divided. The bowel being sphacelated was left at the outer opening, and an artificial anus followed. Through this the whole of the fæces were discharged. Six weeks having elapsed without the prospect of a cure, Dupuytren employed compression, but violent symptoms ensued, and he was obliged to abandon it. He then resorted to the seton. The operation was soon over, gave rise to scarcely any pain, and was not succeeded by any accident. Some days afterwards a skein was substituted for the thread, when flatus began to be expelled by the natural anus. The size of the seton was increased at each dressing, and in less than eight days the patient had a passage from the rectum, preceded by colicky pains. In dressing the sore one day the buttress in front of the foreign body was completely lacerated, without any other effect than a more easy flow of fæces from one end of the bowel to the other. Stercoraceous matter continuing to escape by the abnormal aperture, Dupuytren excised by means of blunt-pointed scissors, directed on the fore-finger, half a line of the septum which intervened between the two openings. The operation was cautiously re-

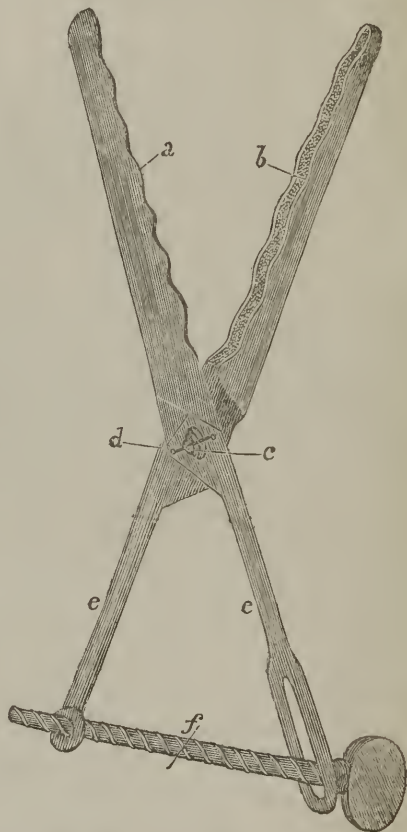
* *Leçons Orales*, T. ii, p. 236. Paris, 1832.

peated at intervals of three or four days, the new adhesions were never passed, and the communication was soon so free that the fæces were evacuated entirely by the accustomed channel. Compression was kept up on the artificial anus, and the case was going on well, when Dupuytren, yielding to the entreaties of his patient, who was anxious to expedite the cure, divided the partition higher up than he had done before. In a few hours acute peritonitis supervened, and the man died. On dissection, a large quantity of serum and lymph were discovered in the abdominal cavity, but no stercoraceous matter, or any opening by which it could have found its way in. The communication between the extremities of the gut was re-established for the space of two inches, and instead of being separated, as they had been previously, they were united by a sort of raphé or cicatrice, the remains of the former septum. In fact, it clearly appeared that, but for the peritonitis, a complete cure would have ensued.

Discouraged by this unhappy termination, Dupuytren determined to abandon the employment of the seton, and to devise some other expedient. After many trials on animals and the dead body, he finally invented an instrument which he called the *enterotôme*, and which is thus described in the second volume of his surgical lectures. It consists of a screw and two branches, each about seven inches long. One of these, which is called the male branch, as it is received by the other, has a blade four inches in length, three lines in breadth, and half a line in thickness at its edge, which is undulated, and terminated by a spheroidal button. At the junction of the blade with the handle is a mortise several lines in extent; the handle itself is from two to three inches long, and has another mortise four lines broad, which runs nearly from one end to the other. The female branch is somewhat shorter. It is composed of two blades, of the same length, breadth, and thickness as the small blade, which is received in the gutter, groove, or sheath between them. The bottom of this gutter is undulated, to correspond with the

irregularities of the male branch, and at the extremity is a cavity for lodging the spheroidal button of the latter. At the union of the groove with the handle is a moving pivot, which passes into the mortise of the other branch, and the handle itself is terminated by a hole to receive the screw. This last part of the enterotôme, a screw of several threads, is an inch and a half long, and ends by an oval plate; it is placed in the mortise of the male branch, and fixed in the female, its use being to separate or close at pleasure the two blades.

The accompanying wood cut conveys an accurate idea of the nature of this instrument. *a* Represents the male blade, *b* the female blade, *c* the joint, *d* the moving pivot, *e* the handles, and *f* the screw by which the branches are shut and locked.



Before applying this instrument the surgeon satisfies himself of the precise situation of the lower opening of the gut, which it is by no means always easy to do, and places the patient upon his back near the edge of the bed, with the abdominal muscles completely relaxed. Taking one of the blades

he conveys it upon the fore-finger into one of the orifices, to the requisite depth, and gives it to an assistant. The other is then introduced in the same manner into the other extremity of the tube, when they are joined together, like a pair of obstetric forceps, by putting the tenon of the one into the mortise of the other. The partition must be embraced to an extent of one, two, or three inches, according to the nature of the case; and the pressure, which is regulated by the screw, should be strong enough to destroy the vitality of the part the first few hours, as this will prevent pain and inflammation. It should afterwards be increased every forty-eight hours, until the enterotôme falls off, which it usually does from the seventh to the tenth day, along with the mortified portion of the partition. The operation is rarely attended or followed by any unpleasant symptoms, and the opening which it leaves generally affords free passage to the fæcal matter from one extremity of the bowel to the other.

From a statement published by Dupuytren in the work previously referred to, it appears that from the time he first employed this instrument until 1824, twenty-one operations had been performed by himself, and twenty by other practitioners. Three-fourths of the cases were caused by gangrene from strangulated hernia, and the remainder by penetrating wounds, with more or less loss of substance of the tube. Of the whole number thus treated three only died; one from supposed fæcal effusion into the abdomen, one from indigestion, and one from acute peritonitis. Of the thirty-eight that survived, none experienced any ill effects except a few who had colicky pains, nausea and vomiting, but were promptly relieved by effervescing draughts, leeches to the anus, and fomentations to the belly. The success was not equally great in all the cases. Twenty-nine were radically cured in from two to six months, and the rest retained, in spite of all that could be done, fistulous openings, which compelled them constantly to wear a compress and bandage, to prevent the

escape of air, mucus, bile, and even fæces. "It would thus appear," says Dupuytren, "that the mortality from the use of the enterotôme is one in fourteen; or, if we exclude the case of indigestion, which cannot be fairly ascribed to the application of the instrument, it is reduced to one in twenty; a result much more favorable than that which usually attends the great operations of surgery."

One cause of failure of this operation, as was intimated in a previous page, is the want of adhesion in the sides of the opening made in the épéron, or septum. Velpeau relates the particulars of a case of this kind which fell under his own observation, and similar examples have occurred in the hands of other surgeons. His patient was a man fifty-six years old, who had a crural hernia of the left side since the age of eighteen: it was somewhat bigger than a hen's egg, became strangulated on the 17th of April, and was operated upon on the 27th of the same month. The intestine was found mortified, and the fæces soon after commenced passing through the wound. The enterotôme, applied on the 14th of May, was removed on the 21st, and the man expired on the 22d, death having been preceded by violent colicky pains, tympanites, and great tenderness on pressure of the hypogastric region. The lips of the two ends of the bowel were quite detached, and the margins of the opening in the intervening septum were adherent only on one side. Thus a free communication was established between the tube and the cavity of the peritoneum, which had become extensively inflamed from the contact of stercoraceous matter, and was filled with sero-purulent effusion.*

It can hardly be doubted that this case would have had a very different termination, had a longer period been allowed to intervene between the application of the enterotôme and the operation for the strangulated hernia. The attachments

* Velpeau, *Médecine Opératoire*, T. iv, p. 157.

between the ends of the intestine and the parietes of the abdomen were not sufficiently firm to resist the traction occasioned by the presence of the instrument, and hence the aperture which permitted the fæcal matter to pass into the abdomen. The want of union in the sides of the opening made by the enterotôme was probably caused by the unhealthy condition of the parts, which indisposed them to adhesive inflammation.

Some difference of opinion still exists respecting the propriety of closing the blades of the enterotôme on their first application so firmly as to destroy at once the vitality of the intervening septum. Dupuytren appears to have pursued this practice in all the cases which he treated with this instrument, without experiencing any ill effects from it. In the hands of others, however, the results have not been so successful. Jobert in particular objects to the plan on the ground of its liability to be attended with severe suffering. In all the cases witnessed by himself the patients were affected with fever, heat of skin, colicky pains, and vomiting; the countenance was livid and contracted, and the symptoms closely resembled those of strangulation. He refers to a case that occurred at the Hotel-Dieu of Amiens, where death was produced by the pressure of the enterotôme, and adds that examples of a similar description have been recorded by different practitioners.* He, therefore, advises that the instrument should be applied rather loosely in the first instance, and gradually tightened until it produces the desired effect. My own experience does not enable me to speak positively on this subject one way or another. In one case in which I employed the enterotôme the blades were applied with great firmness, and yet no unpleasant symptoms followed. The practice seems to me to be perfectly rational, and where bad effects follow, the pressure of the instrument may be diminished at any moment.

**Traité des Maladies du Canal Intestinal*, T. ii, p. 126.

The following is an abstract of the first case in which Dupuytren employed the enterotôme on the human subject. Ménage, twenty-six years of age, was admitted into the Hôtel-Dieu, in January 1816, with an artificial anus in the right groin, produced by gangrene of the bowel twelve months previously. At first the evacuations were passed through the abnormal opening; but eight weeks after the operation, which had been performed for his relief, he was attacked with colicky pains, and had several natural stools, which afterwards recurred, though at long intervals. On his admission, the artificial anus was at least half an inch in diameter, and surrounded by irregular projections of the lining membrane of the gut, while behind a hernial protrusion appeared whenever he exerted himself, and frequently gave rise to invagination of the intestine. The skin around was raw and sore, the suffering severe, the stench intolerable. Having allayed the irritation of the parts, the blades of the enterotôme were separately introduced, as high as they would go, into each portion of the canal, and closed with considerable firmness. No pain was felt, and the next morning the pressure was increased, when slight colic was experienced. In a few days the blades became somewhat moveable. On the sixth, the man had several small evacuations by the natural outlet, and, on the eighth, the instrument fell off, holding in its grasp a membranous band, twenty lines in length by two in breadth. From this period the fæces passed by the rectum, but the artificial anus, though narrowed, still continued open, notwithstanding the employment of pressure, adhesive plaster, and lunar caustic. At length the edges were pared off, and brought together by the twisted suture, aided by a particular instrument. At the expiration of four months the patient was exhibited to the Faculty of Medicine, entirely cured of his infirmity.

Several surgeons, impressed with the conviction that the enterotôme of Dupuytren does not fulfil all the indications which may be expected from such an instrument, have endea-

vored to modify and improve it. It is not necessary to notice all these attempts; I shall glance only at a few of the more important, inasmuch as the principle is the same in all.

Liotard,* a French surgeon, recommends an enterotôme, the blades of which end each in an oval ring, an inch and a half in length by nine lines in width, and so constructed that the blunt crest of one is received in the corresponding gutter of the other. With this instrument he proposes to cut a hole *through* the septum, instead of destroying it from before backwards, as in the method of Dupuytren. He alledges that, when thus executed, the operation is followed by a free passage for the transmission of the fæces, and that the two extremities of the gut are more apt to regain their accustomed movements in the cavity of the abdomen. On the other hand, it has been urged that this instrument is not only difficult of introduction, but that it is liable to grasp a neighboring coil of the intestine or a fold of the omentum. This objection, however, if it is not entirely chimerical, as I am disposed to believe it is, is no more applicable to this contrivance than to the original; which, as has been seen, often embraces the septum to the extent of two, three, or even four inches, without any ill effects. The only objection that I can perceive is, not to the enterotôme itself, but to the manner in which it is used. The portion of the partition left undivided in front, or between the outer orifice and the opening of communication, might possibly interfere with the reparative process, but I am not certain that it would even do this. That it would prevent the cicatrization of the sore, and predispose to the formation of a permanent fistula, as some have pretended, is not very probable.

The only instance in which, so far as my information ex-

* Diss. Sur le Traitement des Anus Contre Nature—Dict. de Médecine, T. iii, p. 365—Jobert, op. cit. T. ii, p. 129—Malgaigne, Méd. Operat. p 572.

tends, the enterotôme of Liotard was used on the human subject, has been recently related by Blandin.* The disease, in this case, was caused by strangulated inguinal hernia, in which six inches of intestine had become gangrenous. The two extremities of the tube lay parallel with each other; the fæcal matter escaping from the superior, which was very tumid externally, and readily admitted the finger. The inferior one was more contracted, and its diameter daily diminished. The superior end formed an irreducible tumor, which Blandin comprehended in a ligature, and it sloughed off on the fourth day. He then constructed an enterotôme composed of two branches, each of which terminated by an oval ring, from eighteen to twenty lines in length, and from six to eight in breadth; the internal surface being marked by alternate elevations and depressions. This instrument was introduced into the extremities of the bowel, to a depth of four or five inches, and compressed by means of a screw. Abstinence and rest were enjoined; no bad symptoms ensued; and the enterotôme separated on the fifth day. On the same evening the patient voided solid fæces by stool for the first time during an entire month. Gas and a yellowish green fluid continued to escape for sometime at the external orifice; but this gradually ceased, and the cure was completed in two months after the employment of the instrument.

Another modification of the enterotôme was proposed by the late Professor Delpech of Montpellier.† He was of opinion that the original instrument divided the partition to too great extent at one time, and that the application of it was liable to be followed, from the contact of fæcal matter, by protracted suppuration, together with ultimate contraction of

* Archives Generales de Medicine, T. xii, Nov. 1836.—British and Foreign Med. Review, vol. iii, p. 520.

† Observations sur l'Anus Artificiel; Mémorial des Hôpitaux du Midi, Février, 1830, p. 76.

the parts, and a partial re-production of the ridge. These inconveniences he thought might be obviated by the more gradual division of the intermediate structures; and for this purpose he devised an instrument fashioned somewhat like a compass, with thin, hollow branches, slightly curved, and terminating each in a sort of spoon, an inch long, and provided with a blunt rim. The branches are united by a screw, and are introduced separately into the bowel upon an ebony gorget. The enterotôme is then locked and secured by a thread or tape to a bandage round the corresponding thigh. When the spoons are applied it is said that they embrace the septum to the extent of *four inches in depth by upwards of an inch in breadth*.^{*} Nevertheless, Delpech considers this instrument as a valuable improvement, and has published a case in which its employment was followed by complete recovery.

The most important modification, perhaps, of the enterotôme, if, indeed, it may not be regarded as an entirely new instrument, was suggested in 1827 by Reybard.[†] It is difficult to convey an intelligible idea of it without the assistance of a drawing. In its general form it resembles a pair of dissecting forceps, slightly curved on the surface for two inches, or to within a short distance of its junction with the branches, which are themselves four inches long, and rounded off at the end. The branches are, moreover, flattened in their entire extent, and fenestrated in the same direction from their origin to within two or three lines of their extremity. Near the handle, on each side of the gutter or slit-like opening just alluded to, are two screws by which the instrument is closed and locked. Introduced into the upper and lower end of the gut, they firmly hold and compress the septum, without contusing it, or depriving it of its vitality. Adapted to the fenestra of the upper branch is a moveable knife, designed

^{*} Dict. de Médecine, T. iii, p. 365.

[†] Mémoires sur le Traitement des Anus Artificiels, et des Plaies des Intestines: Lyon et Paris, 1827.

for dividing the partition to the extent of two or three inches. This section would be attended with hemorrhage, were it not for the pressure exerted by the instrument, which is kept on for about forty-eight hours, or until the adhesions in the adjacent structures are sufficiently firm. In two cases in which Reybard employed his enterotôme, the operation produced hardly any pain, no bad symptoms ensued, and the patient rapidly recovered.

Finally, a new enterotôme, regarded by some American surgeons as a valuable improvement on that of Dupuytren, was invented in 1835, by Dr. J. R. Lotz, of New-Berlin, in the State of Pennsylvania.* The blades, which are six inches in length, terminate each by an oval fenestra, twelve lines long by three in breadth, and surrounded by a narrow, solid rim. They are articulated in the following manner. At the upper extremity, or that which in forceps answers to the joint, and also at the middle of one of the blades, are two steel slides, which are fitted into mortice holes in the corresponding parts of the other blade. Near each of these slides is a screw, of which the posterior passes through one blade, and simply presses on the other, to regulate the distance between them, while the one at the centre of the instrument extends through both blades, approximates them, and presses the edges of the fenestræ against each other.

The mode of applying this instrument does not differ from that of Dupuytren. The blades being unscrewed, and inserted separately into the intestinal orifices, the two slides are introduced into the mortice holes, and the fenestræ brought upon a line with each other. "The central screw is now introduced, and the adjusting screw having been previously turned far enough to allow for the thickness of the double walls of the intestine included between the pinching extremities, the central screw is tightened until the edges of the fenestræ press firmly upon the intervening membranes. By unscrewing the adjusting screw and tightening the central

* American Jour. Med. Sciences, vol. xviii, p. 367.

one, the pressure can be increased to any requisite degree without destroying the parallel direction of the blades."

Dr. Lotz, I believe, has employed this instrument only on one occasion. His patient was a woman forty-one years of age, and the disease, caused by a gangrened hernia, had existed four or five weeks. On the fourth day after the operation, he excised, with a gum-lancet, the portion of the septum corresponding with the fenestræ, and established a direct communication between the two ends of the tube. The instrument was now gradually slackened, and in a week it was removed altogether. On examining the parts, a smooth circular hole was found, about the dimensions of an inch, with the bowel firmly adherent all around. When the case was reported, several months after the operation, the fæces passed nearly all by the natural channel, and the patient was far advanced in utero-gestation. Whether complete recovery ultimately ensued, I am not able to state, as no further account of the case has, I believe, been published.

Having had occasion recently to treat a case of artificial anus, it occurred to me that an enterotome might be devised, much more simple, and in all respects much better adapted to the purpose, than any of those noticed in the preceding pages. Accordingly with the assistance of Mr. Erringer, an ingenious cutler of this city, I had an instrument constructed, of which the following is a description. In its general appearance it closely resembles an artery-forceps, being composed of two blades, and of an intermediate catch. Each blade is five inches in length, and terminates anteriorly in an oval ring, eighteen lines long by eight in width. In thickness the ring does not exceed the twelfth of an inch; it is smooth and convex externally, but the inner surface is undulating, or marked by alternate elevations and depressions. The catch by which the blades are closed is situated at the centre of the enterotome, and is furnished with a rack, for the purpose of regulating the amount of pressure when it is applied to the épéron between the two ends of the bowel. The weight of the instrument is scarcely half an ounce.

The annexed drawing, prepared by my friend Dr Bayless, will explain the nature of this new enterotome more satisfactorily than any description, however elaborate. Figure 1 represents the two blades, the manner in which they are connected behind, and the rings in which they end in front. When they are closed, the depressions of one ring receive the elevations of that of the other, and thus prevent the instrument from losing its hold. Figure 2 exhibits the catch and the arrangement of the teeth of the rack.

The instrument here described and delineated, I have not had an opportunity of employing upon the human subject. In the case adverted to I used an enterotome of a more clumsy construction, the blades of which, connected by a hinge-like joint, were closed

by a central screw, and terminated each in an oval ring, about twelve lines long by eight in width, and perfectly smooth at the inner surface, instead of being rough and undulating, as in the new instrument. It was applied with great firmness, and dropped off at the end of the sixth day, including the portion of the septum which it had embraced. No

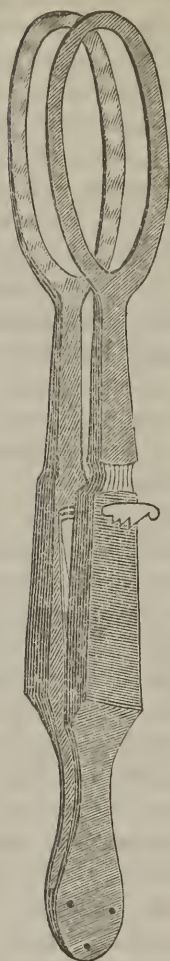


fig. 1

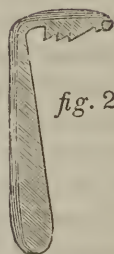


fig. 2

bad symptoms followed the constriction. For the first few hours there was some uneasiness in the part, and the patient, a colored boy, sixteen years of age, complained of slight nausea. These, however, rapidly subsided, and did not subsequently recur. As the case is still under treatment, I shall content myself with the following abstract of it, intending to present a more full report at some future period.

In December, 1840, as I learn from Dr. Ford, of Somerville, Tennessee, the boy was caught in the machinery of a cotton-gin, by which the parietes of the abdomen were torn open at their lower part; the wound extending, on the one hand, from the pubic symphysis to within an inch of the umbilicus, and, on the other, from a short distance above the anterior superior spinous process of the ilium of one side to that of the other, forming a large flap, which was drawn up so as to expose the small bowels. The accident was attended with very little hemorrhage. Dr. Brackin, who saw the boy soon afterwards, brought the edges of the wound together by stitches and adhesive straps, aided by a suitable bandage. Perfect quietude was enjoined, and the most rigid antiphlogistic regimen adopted. After some days the flap alluded to sloughed off, when it was ascertained, for the first time, that the small bowel had sustained some injury. In a few months the opening had contracted to about one-fourth the original size, the intestine adhered firmly to the margin of the artificial anus, and the passage of fæcal matter was easily controlled by a compress and bandage. Several attempts were subsequently made to close this outlet, but they all proved unsuccessful.

When the boy was sent to me, last March, the opening, situated on the left side of the median line, nearly midway between the groin and the umbilicus, was of an oval shape, two inches in its transverse diameter, and fifteen lines in the vertical. The surrounding parts had a raw, excoriated appearance, and the bottom of the ulcer was formed by the two ends of the bowel, lying parallel with each other, the upper orifice being external, the inferior internal. The sore was

nearly half an inch in depth; the edges were bevelled, or depressed towards the centre, and nearly all the fæces flowed in this direction, except when the parts were protected by a compress and bandage. When in the erect posture, there was, at times, a considerable protrusion of the mucous membrane, especially of that of the lower end of the intestine. The intervening septum was well-marked, and formed a serious obstacle to the transit of the fæcal matter from one orifice to the other. The boy's appetite was good, and his general health unimpaired.

Having destroyed the intervening septum by means of the instrument above alluded to, the fæcal matter soon passed, in great measure, along the natural route; but there was no disposition whatever in the opening to contract, owing to the loss of muscular substance. Under these circumstances, I pared away the edges of the protruded mucous membrane of each end of the bowel, and approximated them by several points of the interrupted suture. In this manner I succeeded in obtaining a considerable degree of union; and by repeating the operation, as has been since done a number of times, the opening is so far closed that there is now, June the 20th, only a small slit-like aperture at each angle of the ulcer. By perseverance I shall be able, I think, to effect complete adhesion between the parts, and relieve my patient of his loathsome disease.

In 1820, Mr. Collier,* a surgeon of London, conceived and executed the plan of curing an artificial anus by a sort of *autoplastic* operation. The patient was a male servant, and the aperture, occasioned apparently by a stercoraceous abscess, occupied the right groin, being large enough to admit two thumbs. When Mr. Collier first saw him, two or three months after the formation of the artificial anus, it had considerably diminished in size, and was surrounded by callous edges. When the bowels were constipated the fæces escaped chiefly by the abnormal opening, but when they were relaxed,

* London Medical and Physical Journal, vol. lxiii, p. 466.

or under the influence of medicine, nearly all came away by the natural route.

After several failures to unite the parts by suture and other means, Mr. Collier determined, if possible, to effect a cure by an operation on the principle of Taliacotius. With this view, having pared away the indurated margins of the sore, and converted them into a raw surface about twice the diameter of the artificial anus, he dissected off an adequate cutaneous flap immediately above it, and placing it over the aperture, maintained it by four stitches. A compress and truss constituted the dressings. Complete recovery ensued, without any unpleasant symptoms.

A similar operation was lately executed, with the same happy results, by Mons. Blandin. An account of this interesting case will be found in the *Memoirs of the Royal Academy of Medicine of Paris*, for 1838, and also in the "*Gazette Médicale*" for July of the same year. The patient was a countryman, aged fifty-two, and the artificial anus, produced three years previously by a gangrened rupture, was situated in the inguinal region of the right side where it communicated with the cœcum. Nearly all the fæces passed out at the abnormal opening, which was of a circular shape, and sixteen lines in diameter. There was occasionally also a considerable protrusion of the bowel. After the failure of the more ordinary methods of treatment, a quadrilateral flap of the skin and cellular substance was made just below the opening, by three distinct incisions, and dissected up for the space of nearly two inches, being left adherent by one of its edges to the inguino-crural region. The integuments over the superior internal and external margins of the opening were then removed to the extent of about three lines, when the flap was drawn up and put in contact with the parts, with its bleeding surface looking backwards, and the points of suture placed beyond the circle of the artificial anus. A piece of linen spread with cerate, a layer of charpie, a few compresses, and a truss with a weak spring, formed the dressings. By the fourth day the flap had perfectly united, both externally

and internally, except above, where it became necessary at the end of a fortnight to pare away the opposing edges, and bring them together by the twisted suture. The adhesion after this operation was almost complete, two little holes only remaining, and these speedily cicatrized under the use of the nitrate of silver. The walls of the abdomen were preternaturally feeble at this point, and required to be supported by a truss.

This plan has likewise been tried by Velpeau, but without success. On the second day a yellowish serosity with stercoreous air was observed to escape between the sutures, and the flap was seized with gangrene extending from its edges towards the pedicle by which it adhered to the neighboring parts. The operation of Collier appears to be more particularly applicable to those cases of the disease which are unattended with an intervening septum, and in which the gut retains its normal caliber, or nearly so. It will also be more likely to succeed where the outer orifice is small, and the margin soft and healthy. Under opposite circumstances it can hardly be attempted with the prospect of a favorable result.

Another method, somewhat analogous to the preceding, was put in practice a few years ago by Velpeau.* It consists in making two semi-elliptical incisions around the preternatural aperture, about fifteen lines exterior to it, and in approximating the parts, previously made raw, by several points of suture. The new wounds are filled with charpie, and the dressings are completed by the application of a compress and bandage. The ligatures, which are all introduced before making the lateral incisions, are tied with moderate firmness, and carried through the parts in such a manner as to prevent them from tearing out, or injuring the bowel or peritoneum.

This new operation was executed by Velpeau, for the first time, on the 15th of November 1835. His assistant was Dr. Mott, of New York, and the patient a young man from Nor-

* Médecine Opératoire, T. iv, p. 153.

mandy. As a preliminary step, he pared away the margins of the abdominal aperture, obliquely from the circumference towards the centre, and in such a manner as not to injure the gut, or its mucous membrane. He next introduced four sutures, at intervals of two lines from each other, and with the precaution of not penetrating the abdomen or the intestine. A semi-lunar incision, two inches long, and including the skin, cellular substance, and aponeurosis of the external oblique muscle, was now made around each side of the artificial anus, twelve or fifteen lines beyond it. The parts being cleansed, the operator tied the sutures, and laid a roll of charpie in each lateral wound, to separate its edges. before he applied the dressings.

Three days after the operation there was such an accumulation of alvine matter as to render it necessary to cut away the sutures. The edges of the sore were washed, and the patient, kept as quietly as possible, was allowed a more liberal diet. On the 30th of December the purulent discharge had almost ceased, and by the 4th of January 1836 the fæces had entirely resumed their accustomed route. To render the cure more certain, the patient remained in the hospital until the 8th of February.

The object of this ingenious operation, as will be readily perceived, is to bring the raw margins of the outer orifice in contact with each other, to facilitate their re-union. The artificial anus is thus converted, to use the language of Velpeau, into a sort of basin, the bottom of which is sensibly smaller than the entrance or mouth. The approximation, easily accomplished by the lateral incisions above described, has the effect of completely closing the intestinal portion of the orifice. A strict regimen, perfect quietude, and a gentle enema every evening, will promote the cure.

In 1827 Mons. Colombe,* a French surgeon, suggested the idea of re-establishing the continuity of the two extremities of the bowel by means of a large gum-elastic tube, slightly

* Biblioth. Méd. T. i. p. 389. 1827.

curved, and from two to three inches in length. This is introduced, first, into one end and then into the other, with the concavity resting against the épéron or septum, and secured by a ligature, passed through its anterior wall, to the outside of the abdomen. It is retained in this situation until the passage for the fæcal matter is sufficiently restored, and the external aperture nearly closed, when it is removed, and the case managed in the usual manner. This method was tried by Velpeau* in 1831, but his patient died three days after under symptoms of acute peritonitis. The intestine had been perforated at its posterior part, and the tube projected across the opening, but whether as cause or effect, could not be ascertained.

Another proceeding which has been lately proposed is *excision* of the intervening septum. The operation was first performed, a few years ago, by Mons. Raye, a French surgeon. He seized hold of the épéron or partition between the two ends of the bowel with a pair of polypus-forceps, and cut out a large V-shaped flap with the scissors. No untoward symptoms followed the operation, and the patient promptly recovered. The particulars of this interesting case will be found in the "Gazette Médicale" for 1838.

The artificial anus is occasionally found to open into the vagina, as in the interesting cases mentioned by Casamayor and Roux. In the first of these the posterior wall of the vagina was lacerated during a severe and protracted labor. A fold of the ileum, lying in front of the rectum, was forcibly compressed during the descent of the child's head, and, although it contracted firm adhesions to the tube in question, it became subsequently, like the rest of these parts, involved in gangrene; the deplorable disease alluded to was the consequence. To remedy this, Casamayor endeavored to establish a communication between the ileum and the rectum, so as to divert the fæcal matter from the vagina, which was nearly obliterated by the wound or rent, and make it pass directly

* Médecine Opératoire, T. iv, p. 153.

from one of these intestines to the other. He accordingly constructed a pair of forceps, six inches and a half long, the blades of which were about the diameter of a large quill, and curved in such a manner as to intercept a free space at their base. Anteriorly they terminated each by a ring eight lines long by four in breadth. The patient being placed upon her back, one of the blades was carried along the vagina into the small bowel, about an inch and a half above the abnormal opening, and the other to the same height into the rectum. Having ascertained that the enterotôme embraced nothing but the opposed parietes of the intestines, the blades were approximated and locked. No evil consequences ensued. The instrument was removed six days after its application, leaving above the intestino-vaginal orifice an opening through which the fæces flowed directly from the ileum into the rectum. From this time the natural stools began to be re-established, a small quantity of matter only passing along the vagina. Unfortunately at this period the woman was attacked with a violent inflammation of the lungs and pleura, of which she died in four days.*

In the case related by Roux the procedure was entirely different. After breaking up the adhesions between the bowel and the vagina, he attempted to unite the two ends of the intestinal tube by suture; but the woman soon died from the effects of the operation.†

* Dict. de Méd. et de Chir. Pratiques, T. iii, p. 169.

† Dict. de Médecine, T. iii, p. 371.

EXPLANATION OF PLATE.

Fig. 1 exhibits the outer surface of the small bowel after the application of a ligature, the dog being killed on the eleventh day. The transverse line indicates the seat of the constriction, and the manner in which the lymph, poured out in consequence of the resultant inflammation, re-establishes the continuity of the tube. The new matter is of a pale straw color, firm, and organized. Page 25.

Fig. 2; the internal surface of the same preparation; the mucous membrane has a reddish appearance, and near the centre of the constriction is a small yellowish mass of lymph, containing the ligature. Page 25.

Fig. 3; the outer surface of the small bowel of a middle-sized dog killed four months after the tube had been encircled by a ligature; the part is smooth and polished, and attached to it, at a, is a small process of omentum. Page 26.—b shows the retraction of the coats of the bowel, and the eversion of the mucous membrane, in transverse wounds. Page 11.

Fig. 4 is an internal view of the same section of the tube; the curved line shows the original seat of the constriction; the mucous surfaces are perfectly continuous with each other, the bowel is of the natural caliber, and the reparation is complete. Page 26.

Fig. 5 shows the attachment of the omentum to the outer surface of the bowel, a very frequent occurrence in wounds of this tube. Page 29

Fig. 6 exhibits the size and direction of a wound of the small bowel, at the end of the seventeenth day; the extremities are nearly united, and the centre is occupied by a small mass of lymph, of a yellowish color; the mucous membrane is slightly thickened and preternaturally red. Page 30.

Fig. 7; a longitudinal wound of the small bowel in a more advanced state of cicatrization than the preceding; the lymph has disappeared, the edges of the fissure are nearly in contact, and there is no unnatural vascularity. The animal was killed at the end of four weeks. Page 30.

Fig. 8; the appearance of the mucous membrane four months after the excision of a piece of ileum two and a half inches long; the part is of the natural color, there is no contraction of the tube, and the situation of the injury is indicated by a narrow line, seam, or fissure. Page 168.

Fig. 1.

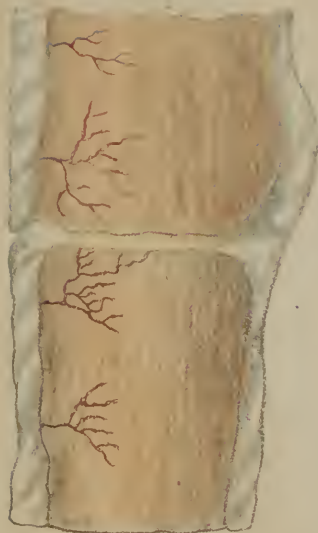


Fig. 2.



Fig. 5.



Fig. 6.



Fig. 3.

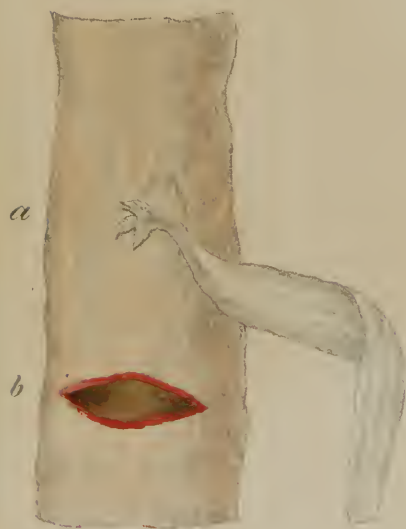


Fig. 4.

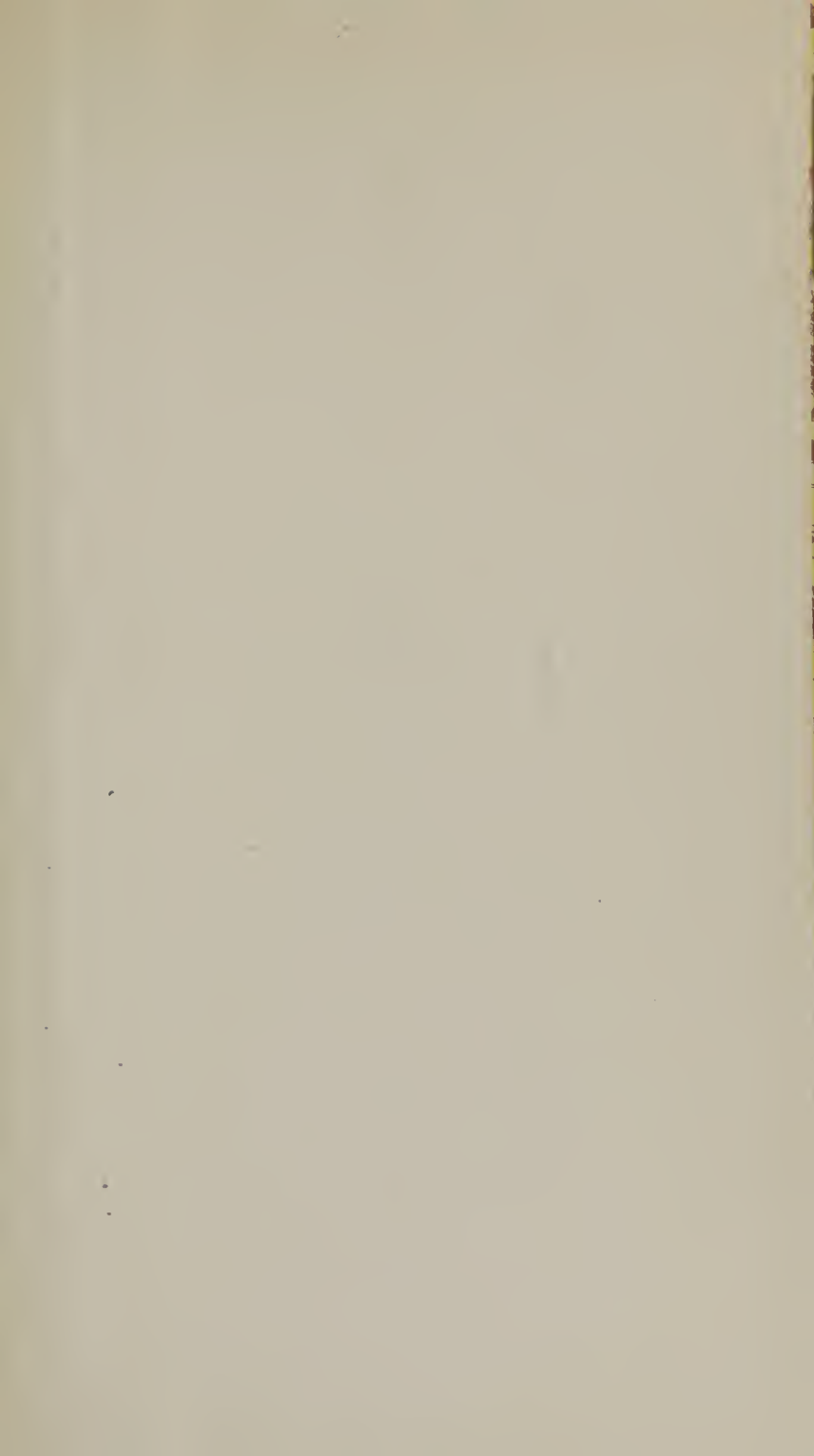


Fig. 7.



Fig. 8.





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